FLIGHT and AIRCRAFT ENGINEER

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The Outlook

"The Position is Dangerous"

THE nation owes a debt of gratitude to Lord Tedder for his outspoken warning about the Royal Air Force. Not since the days of the "father" of the R.A.F., Viscount Trenchard, have we had a chief of the air staff who saw the picture so clearly and who was not afraid of telling the country an unpalatable truth. But a strong C.A.S is not sufficient by himself. His words must be heeded by those upon whom devolves the duty to see that our preparedness in the air is never again allowed to fall to a dangerously low level, as successive politicians of all shades of colour permitted it to do in the years between the wars. Never again must the nation, by the indifference born of non-understanding, suffer "the few" whose gallantry we commemorated last week-end to be the only bulwark against aggression. Lord Dowding has made it only too clear how close we came to defeat at one stage of that critical period in 1940 which none of us will ever forget.

No one would wish to see the Royal Air Force "democratized" in the way Hore-Belisha attempted to alter the Army, very nearly with disastrous results; but what we must obviously do, not only as a common justice but to ensure an air force of the right quality, is to make life in the "other ranks" more comparable with that of the officers. Lord Tedder realizes this to the full, and he epitomized his views admirably in the phrase: "I know of no New Deal, but I do believe in a Square Deal."

The Royal Air Force has become such a highly technical service that the training and skill required for full efficiency cannot be acquired in any short-service period. Conditions of service must be made such as to attract the right type of man and to make his R.A.F. career comparable with any which civil life might offer him.

That is our great problem of the moment. The display at Radlett has demonstrated that we have first-rate equipment. We must also have first-rate men to man and maintain that equipment.

A Magnificent Effort

AVIATION has come a very long way since the Society of British Aircraft Constructors staged its first exhibition and flying display at Hendon in 1932. "Star performers" at that time were the Bristol Bulldog, Fairey Firefly and Hawker Fury, all biplanes.

It is to be assumed that among the guests who visited Radlett last week there were at least a few who attended that early display, and they will certainly have been impressed by the progress made during the intervening years, for although there has been comparable progress in all aircraft manufacturing countries, it is to be doubted that any other nation could have reached such a high standard in all branches as well as excelling, as the British aircraft industry does, in gas turbine development and its applications.

The Gloster Meteor has beaten its own previous record by flying at 616 m.p.h. in very unfavourable weather conditions. At Radlett the tiny de Havilland Vampire was made to look slow by its younger brother, the D.H.108, which gives the appearance of having achieved a higher Mach number than any aircraft produced so far. The new Supermarine E.10/44 with Nene jet unit and thin laminar-flow wings is also an outstanding example of the modern British fighter type.

But it is not only in the fighter class that British progress is to be noted. The Lancastrian which has been fitted with two Nene jet units in the outboard engine positions demonstrates that in the heavy category, too, jet propulsion can have a contribution to make. The absence of noise and vibration when the inner piston engines are throttled back and the machine flies on the jets only gives a foretaste of what commercial flying may be like in the future. The 10,000 lb thrust of the Nenes in the Lancastrian is, of course, equivalent to 10,000 h.p. at the speed of 375 m.p.h. which is about the limiting speed of the existing airframe, but the surplus thrust from all four units is available for a very

useful rate of climb, which has obvious military applications.

Apart from these more spectacular aspects of flying, there was at Radlett an abundance of evidence that British skill and craftsmanship have not, as some of our detractors would have us believe, deteriorated from the high position they held in years gone by. As Mr. Verdon Smith, president of the S.B.A.C., pointed out in his admirably outspoken address to the guests, Great Britain has had to contract the enormous aircraft industry which grew up during the war, but her post-war products will bear comparison with any in the world, and his confident challenge to all potential competitors was good to hear after the vociferous if not always well-informed criticism of Britain's post-war position in aircraft matters. It was high time our habit of self-depreciation should be abandoned, and it was fitting that the voice to do so should be that of the head of the British aircraft industry.

That the technical interest aroused by this magnificent British effort will ultimately be translated into a very welcome increase in our exports is not to be doubted. A very large proportion of the visitors were obviously much more than merely technically intrigued by what they saw. The world is crying out for aeronautical supplies of every sort, and Radlett afforded ample proof that Britain can make it, whether it is a matter of the finest aircraft and power plants, or a question of the too-often unconsidered trifles that contribute their very important share towards the general excellence.

The eighth S.B.A.C. show will, we feel confident, be an even greater revelation than was the seventh. But it must be open, for part of the time at least, to the general public. Our future lies more than ever in the air, and everything that can be done should be done to make John Citizen and Jane his wife realize the fact.

This year it was decided after consultation between police and S.B.A.C. officials that the approaches to Radlett and the accommodation available inside were unlikely to be adequate to deal with the very large crowds which might be expected to visit the show.

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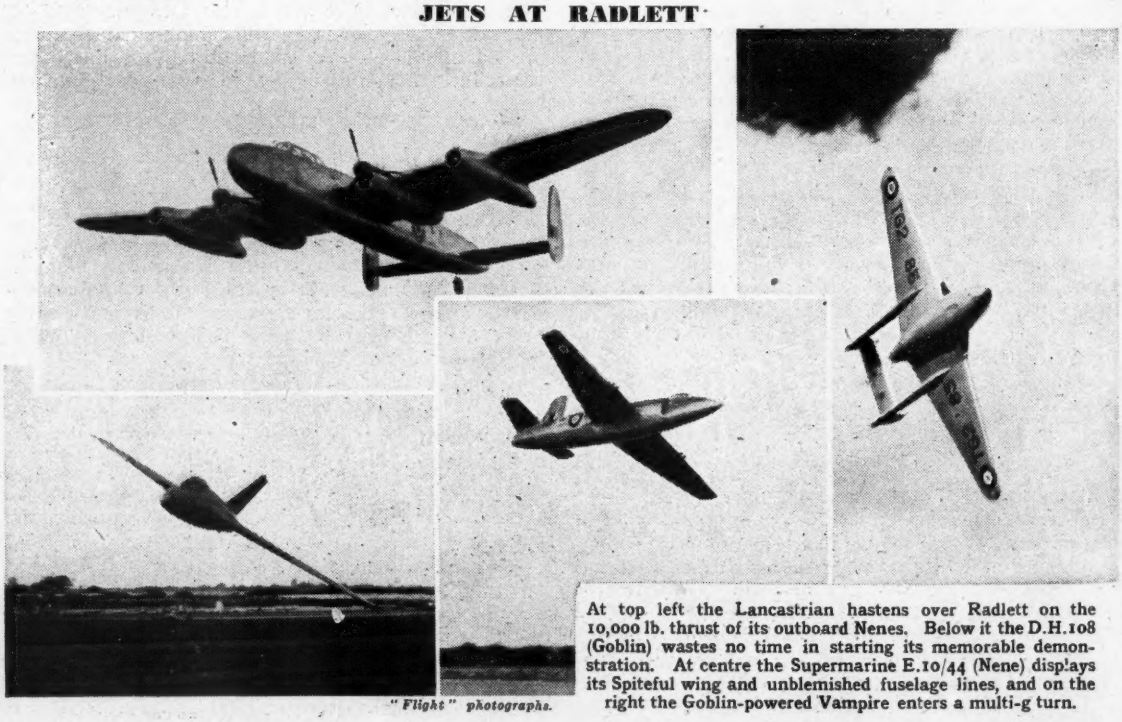
Exhibitors Unfairly Treated

WHILE we agree entirely with the decision of the Society of British Aircraft Constructors that to admit the general public to the Radlett display would have been impracticable, we do feel that the firms which put up such a magnificent show in the static part of the exhibition were somewhat unfairly treated.

Within the limits imposed by space considerations, they had managed to stage their products in a most attractive and praiseworthy style, and had gone to very great trouble and expense over the exhibits themselves, the average quality of which was of a very high order. Yet the guests virtually had but one day in which to study the products of nearly two hundred firms: the Thursday. On the Friday and Sunday the visitors were inevitably drawn outside by the more dynamic attraction of the flying displays.

It does appear to us that at least one extra day should have been set aside for a study of the static exhibits. We are sure Sir Frederick Handley Page would have agreed to a further day's dislocation of the ordinary work of his factory and airfield.

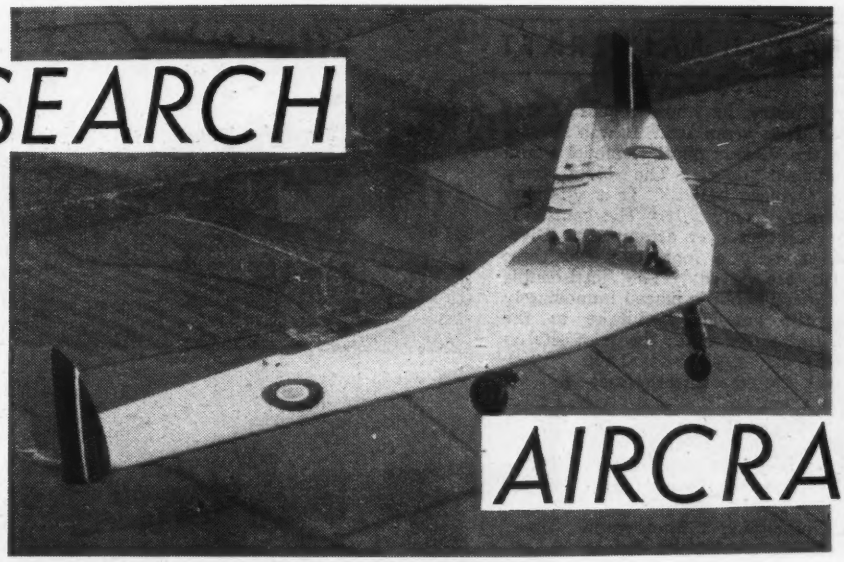
JETS AT RADLETT



"Flight" photographs.

At top left the Lancastrian hastens over Radlett on the 10,000 lb. thrust of its outboard Nenes. Below it the D.H.108 (Goblin) wastes no time in starting its memorable demonstration. At centre the Supermarine E.10/44 (Nene) displays its Spiteful wing and unblemished fuselage lines, and on the right the Goblin-powered Vampire enters a multi-g turn.

RESEARCH AIRCRAFT



The AW 52G tailless glider being towed to height for an experimental flight.

"Flight" photograph

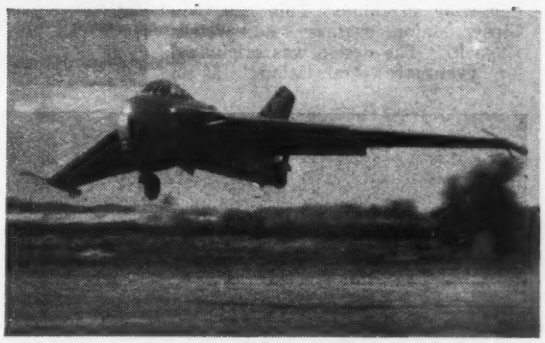
Raising the Mach Number : Tailless and Tail-first Designs : Variable-Incidence

THE metamorphosis in aircraft design, occasioned by new forms of power plant and the approach to sonic speed, has led to the construction of aircraft for pure research. Without exception these types, examples of which will be described, are of great technical interest and foreshadow airframe developments which should enable Great Britain to consolidate the ground gained by her rapid perfection of high-output gas turbine units.

Designed as a flying model of a large powered aircraft, the Armstrong-Whitworth A.W. 52G tailless glider carries a crew of two. It is towed to a height of about 16,000ft by a Whitley tug and released, measurements being taken by automatic recorders during the subsequent glide. The glider is of wooden construction, covered with metal-faced plywood, and is fitted with a fixed tricycle undercarriage. Longitudinal and lateral control are achieved by one surface (known as the controller) which has two forms of balance, by a shrouded forward surface and by a combined geared- and spring-tab. The controller is carried behind a power-operated surface best described as a corrector, the main function of which is to provide a powerful trimming device without impairing the lightness of the mechanically operated small-chord control surfaces.

Directional control is obtained by two outboard fins and rudders, the latter operating differentially to provide a greater angle for the surface which moves outboard.

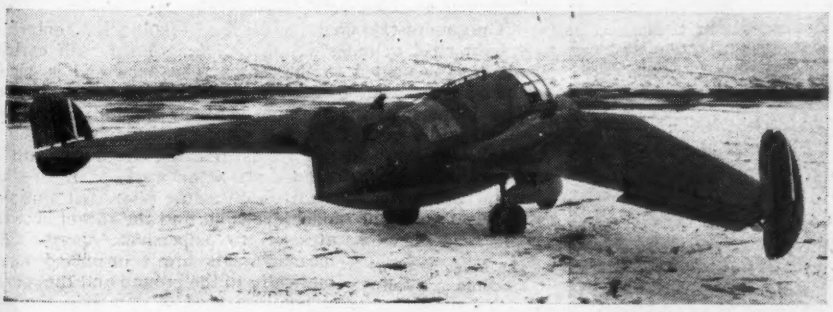
A second British tailless machine, the Handley Page Manx, is powered by two Gipsy Major engines driving pusher airscrews through extension shafts. It has a span of 40ft and weighs 4,000 lb.



Geoffrey de Havilland flying the D.H. 108.

Since May 15th this year tests have been in progress with the De Havilland Type 108 high-speed research aircraft, a type which reflects German technique in wing design but which uses a fuselage similar to that of the Vampire. The D.H. 108 was designed and built solely for the purpose of studying control and stability problems in aircraft with swept-back wings. Not in any sense a "flying wing," it has no tailplane or elevator, the ailerons performing also the function of elevators. The fin and rudder are retained and are of high-aspect ratio, with pronounced sweep-back. In its initial form the D.H. 108 has fixed slots covering half the wing span inboard of the tips. The faired protuberances at the tips carry emergency-control parachutes.

Although in its ultimate form the D.H. 108 will doubtless prove outstandingly fast, its performance might have been entirely overshadowed by the Miles M.52, designed for a speed of 1,000 m.p.h. but which was abandoned "for reasons of economy"



"Flight" photograph

A three-quarter rear view of the Handley Page Manx.

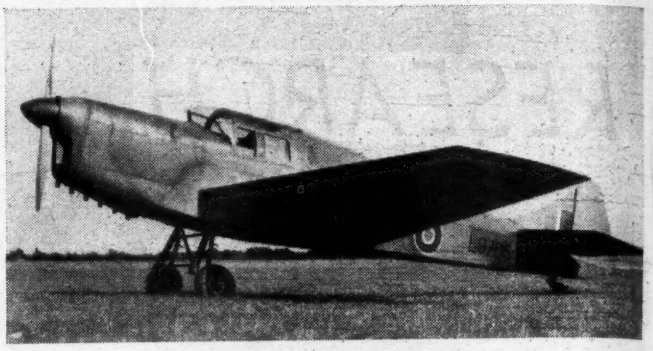
RESEARCH AIRCRAFT

by the Air Ministry, at whose request design was initiated three years ago. It was felt, no doubt, that the Vickers pilotless model would provide sufficient data. The M.52 truly resembles a "winged bullet." It is 33ft long and has a span of only 27ft. The cantilever wing is the thinnest ever attempted. Dive-recovery flaps, only a foot long and three inches deep, are fitted. The jettisonable pilot's pressurized cabin is placed immediately forward of the annular air-intake to the Power Jets turbine-jet unit; the pilot sits on the floor with his feet raised above the floor level, the nose wheel retracting between them.

As the touch-down speed of the M.52 would be about 170 m.p.h. (requiring a two-mile run before stopping), special tyres and wheels were designed.

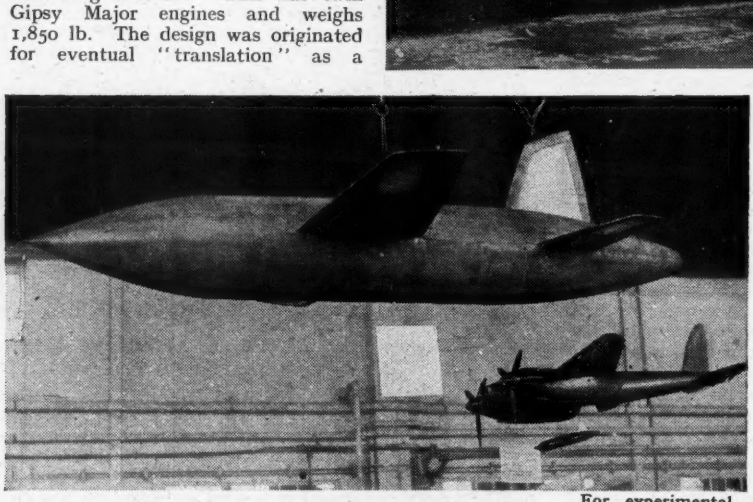
An accompanying photograph shows an experimental Miles Falcon with a "high-speed" wing similar to that adopted for the M.52.

Always ready to try an unorthodox but promising layout, Miles Aircraft built their M.35, or *Libellula*, tandem-wing machine. This has twin Gipsy Major engines and weighs 1,850 lb. The design was originated for eventual "translation" as a



"*Flight*" photograph

(Top) The Miles Falcon with high-speed wing. (Above) The Supermarine 322 nick named "Dumbo."



For experimental flights the Vickers transonic rocket will be launched from a D.H. Mosquito.

"*Flight*" photograph

The Miles M 35 or Libellula is a tail-first aircraft.

naval fighter, but a jet-propelled mail-plane of similar layout was also considered.

Although designed to an official specification for an operational torpedo-bomber, the Supermarine 322 ("Dumbo") may be considered as a research machine, as it is fitted with a variable-incidence wing, the merits of which were fully discussed in *Flight* of April 25th. Alternative hand and electric operation is provided for the variable-incidence mechanism.

The Vickers transonic rocket is a pilotless model, based on the Miles M.52 design and intended for launching from a Mosquito. Its features were fully described in *Flight*, July 11th.

From front to rear the body is packed with fuel tanks containing C- and T-Stoff, air bottles, control servo motors, the auto pilot, a rear T-Stoff tank and a rocket combustion chamber.

The combustion chamber for the bi-fuel rocket comprises a light steel cylinder about 18in long lined with carbon which is cemented to the shell. The open end is coned and a swelled portion of the lining provides a venturi-profile. The diameter of the chamber is about 6in and that of the throat and mouth 1.5in and 3.5in respectively.

In operation the model is released from beneath a Mosquito at 36,000ft and dives at an angle of 10 deg for 15 seconds under the control of its auto pilot. At approximately 1,000ft the model levels out and the rocket accelerates it to supersonic speed. All measurements are transmitted automatically to the ground and the rocket is finally caused to dive into the sea.

HERE AND THERE

LONDON'S OTHER AIR SHOW: A Gloster Meteor IV displayed on the Horse Guard's parade ground in connection with the R.A.F. recruiting campaign.

A Present for Kasja

A SWEDISH journalist, while on a trip by K.L.M., learnt that his wife had presented him with a daughter, so he radioed a message that the baby should be christened Karina Louisa Maria.

Now mamma wasn't keen on these names, but she met her hubby more than half way by calling the infant Kasja Lena Marianne.

As the result was the receipt of a silver christening bowl from the airline, we shall have to try christening our next hopeful, Bernard Oswald Arthur Charles!

Industrial Design

TO coincide with the "Britain Can Make It" Exhibition at the Victoria and Albert Museum, London, opening September 24th next, the Federation of British Industries and the Council of Industrial Design are jointly sponsoring a conference on the subject of Industrial Design on September 26th and 27th, at the Central Hall, Westminster, London.

Among the speakers will be Sir Miles Thomas, D.F.C., M.I.A.E., M.S.A.E. (vice-chairman and managing director, Morris Motors, Ltd., and subsidiary companies), Sir Charles Tennyson, C.M.G. (secretary, Dunlop Rubber Co., Ltd., and chairman of the Federation of British Industries Education and Industrial Art Committees), Mr. Leslie Gamage, M.C. (vice-chairman and joint managing director, General Electric Co., Ltd., chairman, British Export Trade Research Organization) and Mr. T. P. N. Burness, M.I.Mech.E., M.I.P.E., (managing director, Wm Asquith, Ltd.). The chairman will be Sir Thomas Barlow, G.B.E. (chairman, Barlow and Jones, Ltd., and chairman of the Council of Industrial Design).

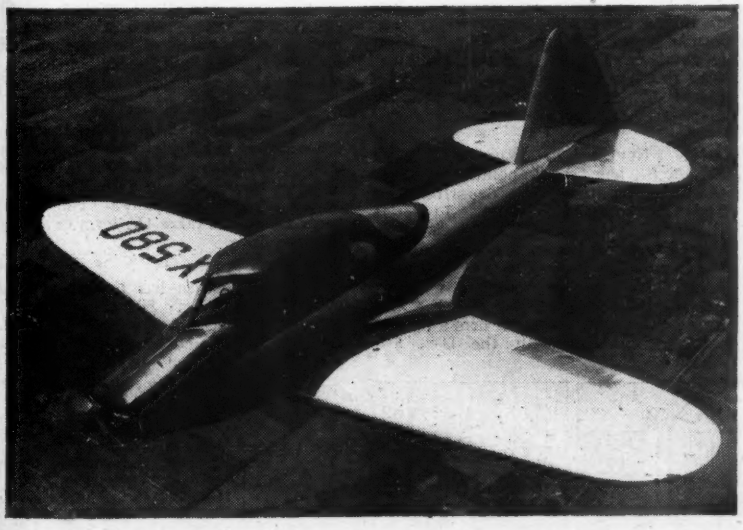
"Spitfire" Scholarships

THE first two scholarships in aeronautical engineering for University College, Southampton, have been awarded by the Spitfire Mitchell Memorial Fund, of which Lady MacRobert is president.

They have been won by A. L. Buchan, aged 20 (Wallasey Grammar School), apprenticed to Saunders-Roe, Ltd., Cowes, and J. Waters, aged 21 (Barrow-in-Furness Grammar School), apprenticed to Vickers-Armstrongs, Ltd., Weybridge.

Of the 40 candidates from all over the country, ten went forward for the final interview by the examining board consisting of representatives of the fund, the college, the R.Ae.S., the S.B.A.C., and Vickers-Armstrongs (Supermarine), Ltd.

The scholarships are tenable for three years, and more will be awarded as subscriptions permit.



LATEST PIPER: Following the usual "Sky" prefix among U.S. light aircraft comes the Skysedan, or Piper PA-6. This is an all-metal four-seater cabin aircraft with a 165 h.p. Continental and a cruising speed of 140 m.p.h. The undercarriage is electrically retractable. The Skysedan will not be in production before next year and the prototype shown here has fabric-covered wings.

Meteoric

THE standard Meteor IV, complete with guns, radio and full Service equipment, which Sqn. Ldr. "Digger" Cotes-Preedy flew to Switzerland to demonstrate to the Swiss Air Force, covered the 270 miles from Paris to Geneva in 32 minutes last week, an average speed of 506 m.p.h.

It was originally intended to fly direct from Moreton Valence (Glos.) to Geneva, but bad weather caused a landing at Paris where Sqn. Ldr. Cotes-Preedy had to wait for two days for better conditions.

Even then, heavy cloud and icing conditions forced him up to 23,000ft soon after leaving Le Bourget, and he never saw the ground again until over Lake Geneva.

The 32 minutes included the take-off and landing, and there was a strong cross-wind for the entire trip, so the actual air-speed was considerably higher than 506 m.p.h.

"Where There's a Will—"

PROBABLY many ex-Servicemen at present penned in this country are anxious to reach some part of our overseas Empire but are being prevented from doing so by the shipping shortage.

Ex-Service pilots, however, have a potential advantage over everyone else in that they can fly themselves (and sometimes their families) to overseas

HERE AND THERE

homes—if their resources run to the acquisition of an aircraft.

Among the latest to adopt this course were two ex-flight lieutenants, C. Y. Brownlow and D. Redman, who, having tried in vain ever since demobilization to get a passage to South Africa, bought an elderly B.A. Swallow, patched it up as well as they could, and valiantly set forth.

The trip took a month because the ancient Swallow held them up for days on end at various stops for further overhauls, but they finally got there, tired out but triumphant.

News in Brief

COPIES of the *Flight* Index to Volume 49 (January to June, 1946) are now available, price 1s 1½d including postage, from *Flight* Publishing Dept., Dorset House, Stamford Street, London, S.E.1.

* * *

The first post-war British Industries Fair is to be held from May 5th to 16th next year at Earl's Court and Olympia, London, and at Castle Bromwich, Birmingham. Special attention is to be devoted to U.K. products suitable for export.

Mr. H. J. Thomas, "Bristol's" next Sheriff.

* * *

Mr. Herbert J. Thomas, a director of the Bristol Aeroplane Company, has accepted an invitation to be Sheriff of Bristol for the coming civic year. Mr. Thomas was one of the team which founded the company in 1910 and was its works manager for 25 years. He is a member of the council of the S.B.A.C. and was its president from 1933 to 1935.

* * *

The 1,010 h.p. Armstrong Siddeley Mamba turbine/airscrew engine, first of the smaller units of this type to be publicly displayed, was exhibited on September 9th in the Pass & Joyce showrooms in Great Portland Street. This unit, intended for civil application, was described in a special issue of *Flight* last week.

* * *

Production of the Canadian aircraft industry in 1944, comprising the primary assembly plants and establishments occupied solely or chiefly in making aircraft parts, amounted in value to $426,981,558, according to a recent report of the Dominion Bureau of Statistics. This compares with $246,028,586 in 1943, and $12,638,470 in 1939.

* * *

Flt. Lt. T. B. Murray, who was an M.A.P. test pilot with Cunliffe-Owen Aircraft, Ltd., during the war and on release from the R.A.F. joined the company as assistant chief test pilot, has now been appointed assistant sales manager on the aircraft side of the business.

* * *

Grp. Capt. J. A. Newton has been appointed sales manager to Portsmouth Aviation, Ltd. He is an ex-Halton boy and gained his wings in 1928. During the war he served in Ferry Command in Canada and later with Transport Command in Britain.

* * *

£1,000 a year, less tax, for seven years, is to be contributed by the Dunlop Rubber Company to help in the renewal and extension of the independent research activities of the Royal Institution and its Davy Faraday Research Laboratory.

* * *

Mr. W. D. Rae, B.Sc., A.R.I.C., chief research chemist at the Andre Rubber Co., Ltd., has been awarded his Ph.D., his thesis being "Some studies in the bonding of rubber to metal."

* * *

Dr. Edwin Gregory and Brig. Arthur Levesley have been appointed directors of Edgar Allen and Co., Ltd. The former joined the firm in August, 1944, as chief metallurgist, and the latter was with the firm from 1910 to 1928 and rejoined it last October as foundry manager.

* * *

Mr. Neville L. Lupton, M.A., F.R.Ae.S., has been appointed manager of the aeronautical sales department of The Sperry Gyroscope Co., Ltd., at Brentford. Mr. Lupton, who succeeds Mr. J. Vivian Holman, was a member of the Cambridge University Air Squadron, joined the Sperry concern in 1941 on being invalided out of the R.A.F., and from 1942 to 1945 was the firm's technical representative with the U.S. 8th Air Force.

MODEL AUDIENCE: Youthful admirers watch a model aircraft being started up during a recent meeting on Epsom race-course.

Four ex-R.A.F. pilots have recently joined the King's Norton factory of the Triplex Safety Glass Co., Ltd. They are Flt. Lt. W. Brown, Sqn. Ldr. J. M. Derbyshire, Wing Cdr. P. R. Gaskell, D.F.C., and Sqn. Ldr. W. C. Timoney, D.F.C.

* * *

A wide variety of air freight arriving at London Airport is now being handled by the G.W.R. at Hayes station. During the last few weeks this has included blood plasma, books, bulbs, bees, orchids from the U.S. for a Liverpool wedding, the recorded voices of a bridegroom's parents in Australia for a Plymouth wedding, and—at the other extreme—a casket of human ashes.

* * *

Aerial survey of the Kentish hop gardens is being made in the hope of gaining more useful information on the cause of a serious outbreak of wilt, a disease which seems to be more virulent each year. Research has shown that certain varieties of hops resist the disease.

* * *

A new aircraft wire, coated with a fire-resistant synthetic rubber and 30 per cent lighter than normal wire, is reported to have been introduced by the United States Rubber Company. The flame-proof insulation takes the form of a layer of glass fibre.

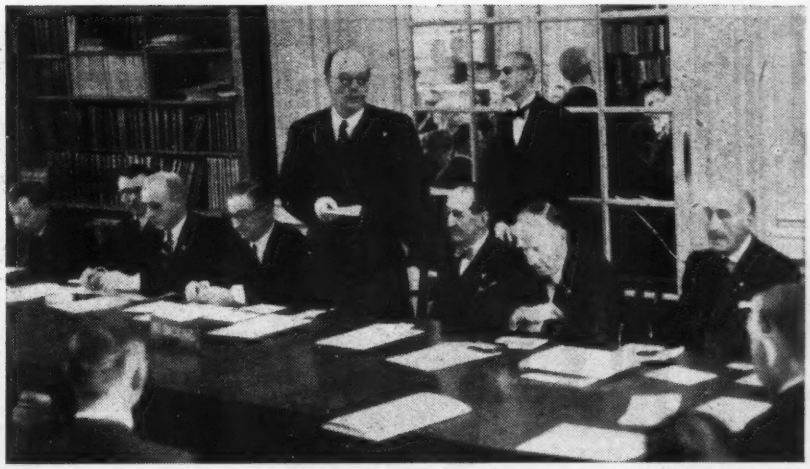
* * *

Mr. J. L. Smith has been appointed to the board of Hunting Aviation Management, Ltd., and Mr. C. P. M. Hunting has joined the board of Hunting Air Travel, Ltd.

AIRSTRIP . . . No. 31

The F.A.I. in London

First Post-war General Conference Attended by Delegates from 18 National Aero Clubs



"Flight" photograph.

Lord Brabazon of Tara, who was later elected president of the F. A. I., welcoming the delegates in the library of the Royal Aeronautical Society.

LORD WINSTER, Minister of Civil Aviation, welcomed the delegates sent by 18 national aero clubs to the 39th general conference of the *Fédération Aéronautique Internationale*, held in London this year, the Royal Aero Club of the United Kingdom being the hosts, and the Royal Aeronautical Society having placed its premises at the disposal of the conference, which lasted three days. On the fourth the F.A.I. delegates attended the S.B.A.C. flying display at Radlett.

The F.A.I. was founded in 1905 in Paris by eight countries: Great Britain, France, Germany, United States, Belgium, Italy, Spain and Switzerland. In time other countries joined, and at present the national aero clubs of 26 countries are members of the F.A.I. Not all were able to send delegates this year but the following 18 were represented: Belgium, Brazil, Canada, Czechoslovakia, Denmark, Egypt, France, Great Britain, Luxembourg, the Netherlands, Norway, Peru, South Africa, Spain, Sweden, Switzerland, Turkey and the United States. In addition to the delegates of national aero clubs, P.I.C.A.O. sent two representatives.

Many subjects were discussed, including amendments to existing rules governing world's records, the various aspects of private flying on which international agreements are essential, the regulations for air races, gliding certificates, and many others.

In welcoming the delegates, Lord Winster stressed the importance of international collaboration, but took a pardonable nationalistic pride in recent British achievements, some of which, such as the new records for the London-Karachi, London-Darwin, and London-Wellington, N.Z., runs, the F.A.I. has recently recognized, and the new world's speed record of 616 m.p.h., which would soon be submitted to the F.A.I. for homologation. But for bad weather the figure would have been over 1,000 km/h. He recalled the fine work done by the F.A.I. in the re-establishment of the *Carnet de Passage en Douane*, which was such a help in easing the path of private fliers between one country and another, and which was now recognized by about a dozen countries.

Lord Brabazon of Tara, president of the Royal Aero Club of the United Kingdom, pointed out to the delegates that they were on "holy ground": the premises of the Royal Aeronautical Society, which was the oldest aeronautical body in the world. The conquest of the air had left its marks on London, which was not now the London the delegates had known. It was, he said, a shabby town, but still a proud city. He recalled the inspiration given to so many unfortunate European countries during the war by the broadcast of Big Ben.

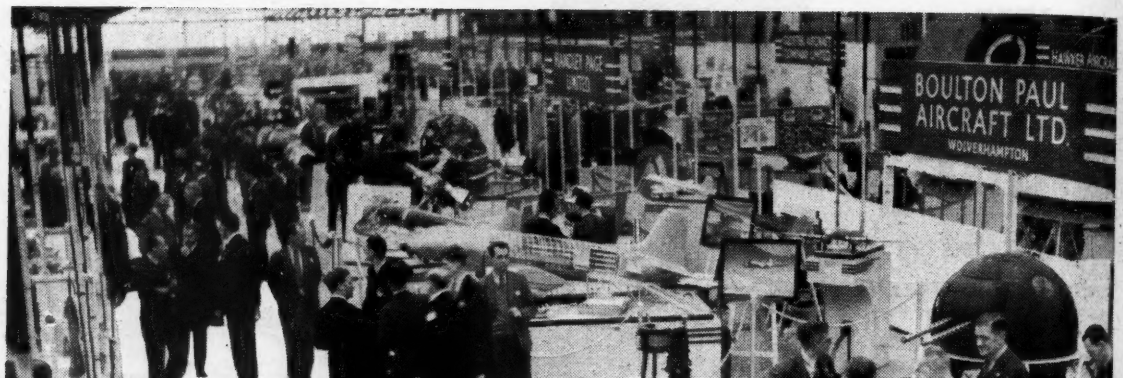
Jkr. van den Berch van Heemsteede, of Holland, speaking in French, thanked Lord Winster for his welcome and recalled that but for Great Britain there would have been no freedom to hold such conferences as this one. In spite of many difficulties the F.A.I. had been able to carry on during the war. He paid a tribute to those who had passed away, asking the assembly to stand in silence for a minute. The international organization of sporting and touring flying, he continued after the silence, would demand all the energy of the conference.

Col R. L. Preston, secretary-general of the Royal Aero Club of the United Kingdom, in reporting to the conference, pointed out the great difficulties under which the various national aero clubs had worked recently. He urged delegates to go back to their countries and get their aero clubs to do all they could to get rid of existing restrictions.

On September 10th the delegates were the guests of Mr. Whitney Straight, chairman of the Royal Aero Club, at a reception at the Royal Aeronautical Society, and the next evening Lord and Lady Winster received them at a Government reception at the Savoy Hotel. On September 12th the delegates were the guests at the R.Ae.C. dinner.

"Flight" photograph.

AT THE R.Ae.S. RECEPTION: (Left) Capt. E. Sandberg (Norway) with Capt. H. S. Broad who is on the racing committee of the R.Ae.C. (Centre) Sir Lindsay Everard, Col. Gerber (Switzerland), and Mrs. Kenneth Davies. (Right) Mr. Whitney Straight, centre, receives Mr Ivor Thomas, left, and Lord Winster.



SEVENTH S.B.A.C. DISPLAY

Radlett Exhibition Outclasses All

Previous Shows : Guests Impressed by British Genius

Illustrated by "Flight" Photographs and Sketches

Representatives from some 50 countries attended the two-day display and exhibition staged at the Handley Page airfield at Radlett last week. The products of firms in the Society of British Aircraft Constructors impressed the guests by their range and variety no less than by their high qualities of design and workmanship.

As Mr. Verdon Smith, president of the S.B.A.C., pointed out in his welcoming address, there is scarcely a science or industry which does not contribute to the creation of modern aircraft, its power plant and equipment.

It is an indication of the virility of the British aircraft industry that it should have been able to assemble such a magnificent display so soon after the end of the war. No fewer than 194 firms were represented in the static exhibition while 55 aircraft types (22 of them civil) were available for inspection, and many of them took part in the flying display.

The guests were particularly impressed by the proof of British progress in gas turbine development afforded by the power plants shown and the performance of the aircraft in which they were installed. Our lead in that field is now unquestioned, but it will certainly not remain unchallenged.

THE Radlett Display and Exhibition was no mere trade fair; a preponderance of military machines—in some cases fresh from the Secret List—gave it a deeper, though certainly unintended, significance. Few visitors could have sworn that their interest was entirely commercial, nor even recreational, for it is an inescapable fact that the quality of British Service aircraft is a universal concern.

An inspection of the machines in the flying display and exhibition park was firmly reassuring and aesthetically satisfying. To that many-faced character the "student of military aircraft design" the display was probably the most significant to date, if only because three distinct types of jet fighter were present in addition to one semi-jet heavy aircraft developed from a bomber.

The Supermarine E.10/44 is news, even to readers of *Flight*, and attracted a large proportion of the visitors. When Mr. Jeffrey Quill parked this latest prototype jet fighter at Radlett, on Wednesday, the machine gave an instant impression of solidity. Liberal use of heavy-gauge material with a remarkably smooth surface, combined with the general proportions of the machine, suggest one of those "near-solid" supersonic aircraft lately described by aerodynamic visionaries. The fine-limit workmanship is not only superficial; internal surfaces of the "elephant-ear" intake ducts are subtly formed to give the most efficient airflow to the Rolls-Royce Nene snugly installed aft of the tank bay. The nose is of massive construction to provide pilot-protection and there are heavy strips of metal round the beautifully formed enclosure over the pressurized cockpit. Other points noticed were the dihedral tailplane; double tail wheel (permitting complete retraction beneath the jet pipe); filled rivet heads; wooden end-caps on tail surfaces; and above all, the amazingly clean fuselage, with the cockpit enclosure and jet intakes as the only excrescences of any consequence. The ejector jack for the pilot's seat is cordite-operated.

A speed of 600 m.p.h. is claimed for the E.10/44.

Rivalling the E.10/44 in modernity of line (and sur-

SEVENTH S.B.A.C. DISPLAY

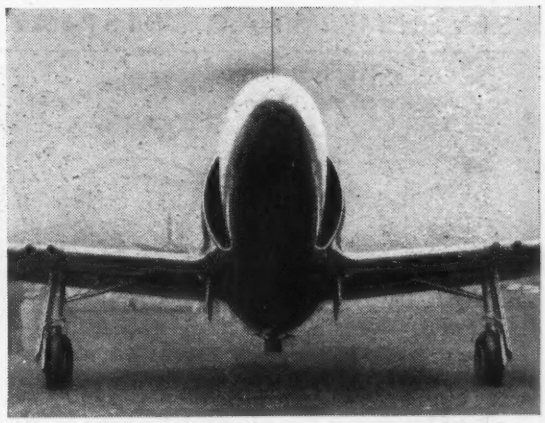
passing it in having a tricycle undercarriage) the new short-span version of the Gloster Meteor IV stood unshamed alongside the stylish Supermarine. The Meteor displayed was from Gloster's Experimental Flight, but before long all Mark IV fighters for the R.A.F. will have the abbreviated wing, which gives improved rolling characteristics, and the new-pattern ailerons. Mr. Phillip Stanbury delivered the Meteor from Moreton Valence in eight minutes.

Supermarine Fighters

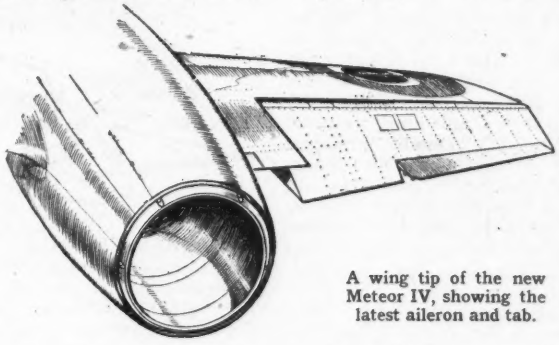
The Spitfire/Seafire and Spiteful/Seafang family was represented by a Seafang 32 and a Seafire 47. The compact and beautiful Seafang must be the fastest airscrew-driven naval fighter in the world. According to Supermarine's latest figures, made available at Radlett, it attains 475 m.p.h. at 21,000ft—only 8 m.p.h. less than the Spiteful at the same height. This is a truly remarkable achievement considering that the machine is airscrew-driven and that it is encumbered with lashing-down and slinging points; arrester gear; provision for rocket-assisted and accelerated take-off, rocket projectiles or bombs; camera ports; and other miscellaneous hindrances to performance, including power-folding outer wing panels. Of the various combinations of jettisonable tanks which can be fitted on the Seafang (up to 180 gallons can be carried externally) some are stressed for combat. On the debit side the Seafang has a rather longer take-off than the 452-m.p.h. Seafire 47. With a 30 m.p.h. wind over the flight deck and with flaps in take-off position, it will leave a carrier's deck in 457ft, whereas the Seafire under the same conditions requires only a 378ft run before unsticking.

The latest figures for the Seafang are: Normal all-up weight 10,450lb; maximum all-up weight 11,900lb; rate of climb at 17,200ft, 3,970ft/min; service ceiling 32,000ft.

The manifest merits of the D.H. Vampire and Sea Vampire demand no new appraisal and no modifications were noted on the Hornet and Sea Hornet, nor on the Mosquito PR34. De Havillands, however, staged something of a *tour de force* in showmanship by exhibiting the prototype Mosquito "W 4050" with a selection of military loads which the type was eventually developed to carry, including bombs, tanks, R/Ps and cameras.



Heavy plating provides protection for the pilot of the E.10/44



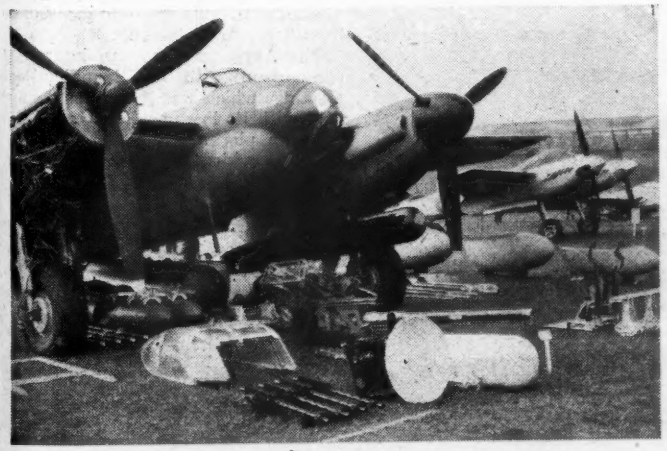
A wing tip of the new Meteor IV, showing the latest aileron and tab.

A new version of the Firebrand single-seat naval strike aircraft—the Mark V—was Blackburn's offering. Superficially this mark differs little from the familiar Firebrand IV but has improved horn-balanced elevators, aileron tabs of longer span and square air intake for the oil cooler. Equipment now includes an A.S.V. radar installation in a transparent fairing inboard of the guns in the starboard leading-edge. Mr. P. E. G. Lawrence fully convinced us by demonstration that the slatted dive-brakes can be fully extended in half a second.

Hawkers gave some interesting new data concerning the Sea Fury X, which was shown in company with the 485-m.p.h. Sabre-engined Fury I. With a Centaurus XVIII the Sea Fury attains 440 m.p.h. at 21,000ft and has an initial rate of climb of no less than 4,690ft/min; it reaches 25,000ft in 7 minutes. With a 20-degree flap setting and helped by a 27-knot wind, the machine leaves a carrier's deck in 343ft, flying at a weight of 11,000 lb. At 14,000 lb the run is 635ft. It was disclosed that at the latter weight the load can include four 20 mm guns with 580 rounds, two 45-gallon tanks and two smoke curtain installations. Other loads are Triplex R/Ps with 180 lb heads, together with 2×500 lb bombs; and 12×3-inch R/Ps.

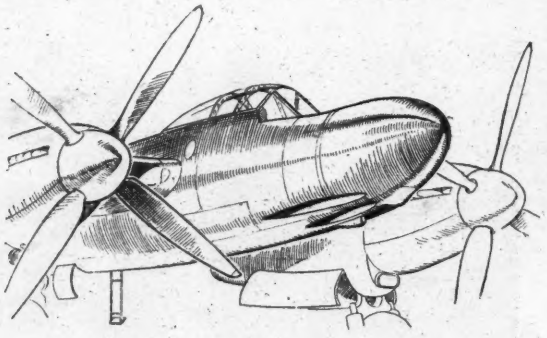
The amazing variety of loads which can be handled by British service aircraft was quite a feature of the display, and it was interesting to see that the Firebrand and Brigand flew with representative external loads—in the case of the Brigand, a torpedo in addition to R/Ps beneath the wing. With its two Centaurus 57 engines the Brigand combines exceptional versatility (this is, of course, a prerequisite in a Beaufighter replacement) with long range and a surprisingly high performance. The "bellows" dive brakes intrigued many overseas visitors.

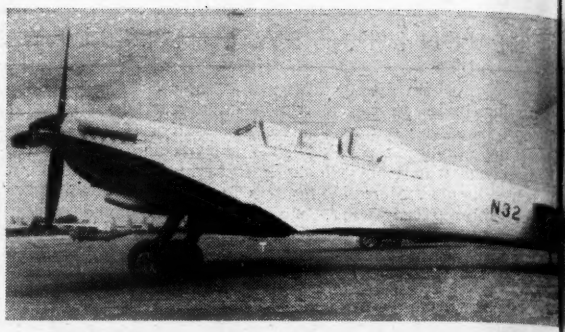
The massive Buckmaster trainer contrasted with the little Reid and Sigrist Desford and with the Spitfire and Firefly dual conversions.



A unique exhibit—the prototype Mosquito and representative "Mossie" loads.

SEVENTH S.B.A.C. DISPLAY





Left: Nose of the Welkin II night fighter. Above: The Spitfire Trainer, which attains 390 m.p.h. Its service ceiling is still over 40,000ft.

The latter has already been adequately described in *Flight*, but the following details of the dual Spitfire are new.

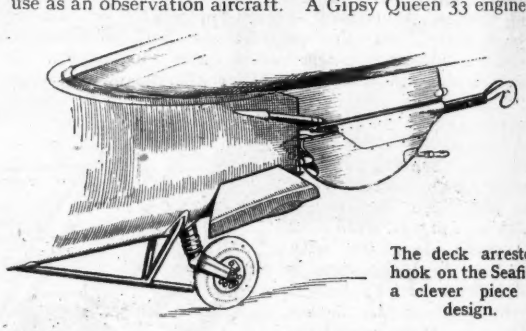
The Spitfire Trainer can be converted from most marks of Spitfire fighter to meet customers' requirements. Essential controls and instruments are common to both cockpits and both hoods are jettisonable. There are four wing tanks, in addition to a fuselage tank, and a drop-tank is optional. Figures for a converted Mark VIII Spitfire are: flying weight, 7,400 lb; wing loading, 30.6 lb/sq ft; maximum speed, 390 m.p.h. at 20,000ft; stalling speed, 80 m.p.h.; service ceiling, 42,000ft.

Supermarines provided some facts concerning their interesting new S.14/44 amphibian flying boat, intended as a replacement of the Sea Otter. The S.14/44 has a top speed of 240 m.p.h. and its single Griffon engine drives a six-blade, contra-rotating airscrew as a pusher. Technically the most notable feature is the variable-incidence wing, developed from that of the Type 322 ("Dumbo") referred to on page 296. This wing has exceptional lift characteristics and is fitted with full-span leading-edge slats and slotted flaps. For landing (the type is designed for carrier operation) it is possible to achieve the high lift coefficient for which the wing is designed without undue drag in level flight. Data relative to the S.14/44 are: Span, 50ft 6in; length, 44ft; width folded 23ft; crew, three.

The new Supermarine amphibian compares in size with a second deck-landing machine of recent production—the Short Sturgeon reconnaissance-bomber aircraft with two Merlin 140 s.p. engines. Shorts gave the following figures for the Sturgeon: Gross weight, 20,400 lb; length, 45.5ft; span, 59.92ft; range, 1,650 miles.

Largest of all the deck-landing aircraft, however, was the Fairey Spearfish which displayed its capacious bomb or torpedo stowage. The dorsal barbette, housing 2 × 0.5-inch guns, was a mock-up.

Another design of unusual technical interest, shown in model form, was the little Heston Aircraft twin-boom monoplane designed to the order of the Ministry of Supply for use as an observation aircraft. A Gipsy Queen 33 engine is to be fitted. The square-cut wing is fully slotted and flapped and the undercarriage is a tricycle. The cockpit seats two, and its sides are bowed to give maximum view. Data are: Gross weight (normal), 3,050 lb; wing area, 274 sq ft; span, 44ft; length, 34ft; height, 9ft.



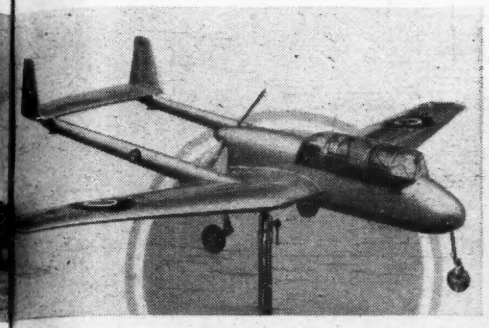
The deck arrester-hook on the Seafire, a clever piece of design.

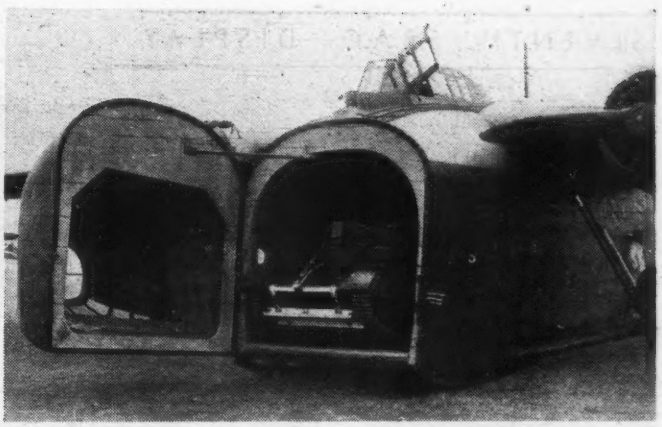
Another new military machine shown in model form, but of totally different character, was the Airspeed Ayrshire C Mk. I which weighs 52,500 lb and is designed for the fast transport and handling of military cargoes. Its useful load was quoted as "in excess of 6½ tons" and its stowage capacity as 2,765 cubic feet. Airspeed point out that the Ayrshire is the first production-type aircraft of over 50,000 lb to incorporate level-floor direct loading.

The Ayrshire makes an interesting comparison with the Handley-Page Hastings which was shown on the air field with its loading doors agape and ramp in place.

It was evident that the General Air-

For Transport Command: Above is the military Vickers Viking, with its new Service markings, and on the right the Handley-Page Hastings, showing the loading door in the port side and the special loading ramp. The military Viking is, a modification of the civil type, whereas the Hastings was designed primarily as a service transport



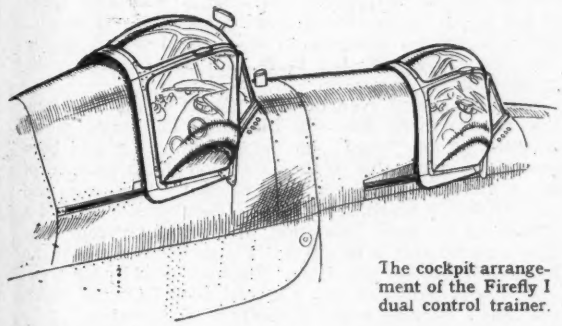


The Heston A.O.P. (above) is fully slotted and flapped. The bowed sides of the transparent cockpit enclosure give excellent view. On the right is the Mercury-assisted Hamilcar X.

craft "Universal" transport, publicized as a civil machine, would make another outstanding military transport.

Although the civil representation at Radlett was somewhat overshadowed by the military exhibits, most of the better-known new types were to be seen, and hints of the future were given in model form.

The only available Tudor II was at Boscombe, but a I, six of which have now, we hear, come off the production lines, was to be seen, and B.O.A.C. managed, after all,



The cockpit arrangement of the Firefly I dual control trainer.

to loan a York, of the combined passenger-freighter type, as well as one of their Handley-Page Haltons. Though not essentially an Avro exhibit, one of the two Lancastrians to be seen was a research type with two R-R Nenes replacing the outboard Merlins. One of the new Avro XIXs, with stressed-skin metal wings, was also shown.

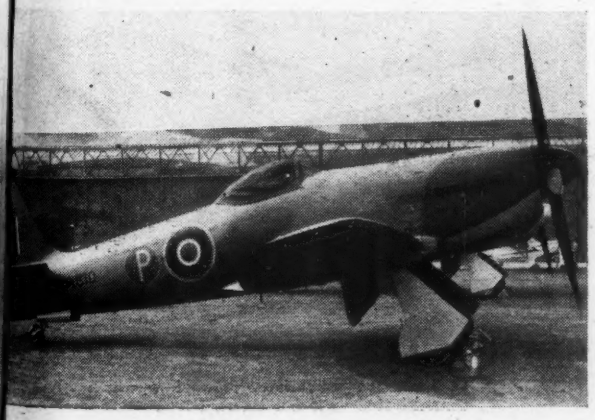
The Vickers Viking on display had, as it happened, come off the line at midday on the Thursday before the opening of the show, and was flown over that afternoon on its initial tests. This was a stressed-skin-wing 1A—the short-nosed version—for R.A.F. Transport Command, and the first of the series fulfilling this order. From the visitor's point of view, however, it was entirely similar to the civil version ordered by B.E.A.C. and others. Incidentally, this Viking was fitted with metal Rotol airscrews. It is not generally known that the "belly" freight loading in the Viking is arranged in five different compartments below the cabin floor level, each of these compartments having the maximum load figures clearly indicated on the appropriate door. Indoors was a model of the Viking fitted with R-R jet units and inscribed with a maximum speed figure of 450 m.p.h. by way of pure-jet comparative performance indication.

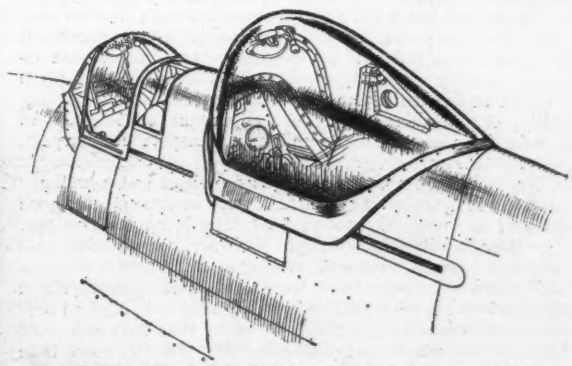
Miles Types

Four Miles civil aircraft were on view, including the new Marathon—complete with stick-force test recorder on the starboard control column—and the twin-engined Gemini in latest production form, with electrically retractable undercarriage and Decca Navigator panel. The Messenger shown was, in fact, an M.48 rather than an M.38, with electrically operated retractable flaps. This aircraft was due to be flown away for a Swiss customer. The fourth Miles exhibit was an Aerovan. In the static exhibition there was a model of the Marathon as it will appear with two A-S Mambas.

In addition to the Prentice Trainer and Proctor V, Percivals were indirectly showing one of the earlier Gull Sixes in which Miss Jean Batten made a record flight to Australia and New Zealand in 1936, while in the static show there was a full-sized mock-up of a fuselage section of the Merganser, which should be flying during the next month or two.

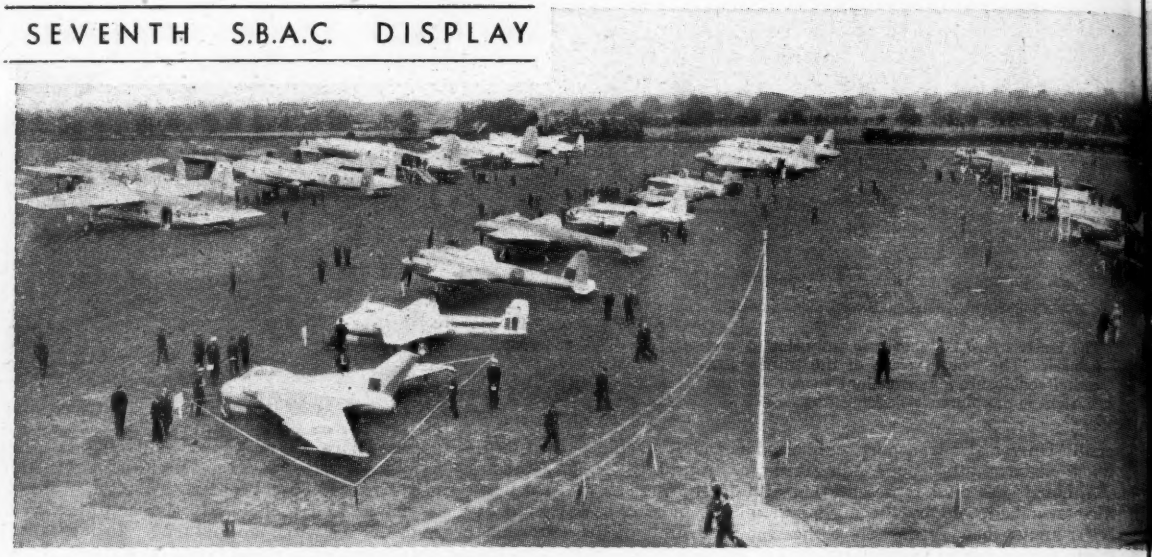
Apart from the Autocrat and the new military observa-





The Sabre-engined Fury I (left) is one of the cleanest air-screw-driven machines yet built. Above are the neat cockpit enclosures of the Spitfire Trainer.

SEVENTH S.B.A.C. DISPLAY



tion Auster VI, one of the new Arrows was to have been shown. This was regretfully wheeled away out of sight on the day before the opening of the exhibition because someone or other noticed that it was fitted with an American Continental engine. "Inside" was a sectioned Auster fuselage in full size.

More interesting, perhaps, than the real-life D.H. Dove was the cabin mock-up which could be reached by more enthusiastic visitors in its corral near the static exhibition. This had been laid out for private ownership with four chairs which could be made into two bunks, tables and two additional chairs. Nearby, though again not a very official exhibit, was the old T.K.2 single-seater built long ago by the de Havilland Technical College students and now just out again after its post-war C. of A.

General Aircraft

Primarily of military interest, the power-assisted Hamilcar X may yet be seen on civil freight-carrying work. It looked somewhat over-burdened with its two Bren-gun carriers, but it had actually been flown over so loaded. The other General Aircraft type was in model form only—the new Universal transport 90-seater, on which design work is now proceeding. Another model of unusual interest was that of the Armstrong-Whitworth 55 with its four A-S Mambas.

Although still considered by many as the "Freighter," the Bristol 170 is now very passenger-conscious and the aircraft on exhibition was actually the latest thirty-two-passenger Wayfarer with a steward's galley in the nose.

Those who knew the Oxford so well during the war will have been surprised by the considerable metamorphosis of the interior of its civil development, the Consul, with its five passenger seats and a radio operator, taking the place of that of the instructor. Looking farther ahead, the big AS-57 Ambassador could be seen in the static show in model form alongside its military transport counterpart, the AS-60 Ayrshire.

No Handley-Page Hermes was on view, but a military transport Hastings on the airfield gave visitors a very good idea of the usefully unobstructed interior of the fuselage. On the Handley-Page stand, however, information was available about yet another type in the Hermes series—the Mark IV, which will have a tricycle undercarriage. Otherwise the IV is generally similar to the II, and will be pressurized for operation at more than 20,000ft. At 26,000ft its maximum cruising speed is given as more than 300 m.p.h. As in the case of the Mark III, this version will, in due course, be fitted with Bristol Theseus airscrew-turbines.

Although a Sandringham was due to be flown, Short Brothers' exhibits were necessarily confined to models of the various types, and to a full-size mock-up of a Solent passenger cabin interior. Some new figures were available for the Sealand amphibian—including a maximum speed of 193 m.p.h., a maximum cruising speed of 182 m.p.h., and a maximum economic cruising speed of 179 m.p.h. The best range, with full tanks, will be 813 miles while cruising at 127 m.p.h.

More impressive even than the model of the Saunders-Roe 120-ton flying boat was the single hull-frame shown mounted on an "easel" on the airfield. If it had been possible to house this in the exhibition the impression of size would have been even more marked. Those who had not previously heard of the Gouge docking scheme had a chance, in the static exhibition, of seeing a far-from-static model demonstration in which it was shown how a boat can be moored fore and aft without boathook effort by the crew, and afterwards drawn into a special dock. On the stand, too, was a working model of the type of "splitting" fully retractable wing-tip float which will be used in the S-R-45 giant.

Sailplanes were represented at Radlett by two Slingsby

Mr. P. E. G. Lawrence with the Firebrand V which he demonstrated with full external load

The aircraft park at Radlett: the scene on Thursday. The D.H.108, on the left, is roped off to keep too inquisitive visitors from seeing too much.

types—the Kirby Kite II and the Falcon—built by Martin Hearn at Hooton Park.

Of the power plant aspects of the show there is little to add to that which has already appeared in these pages.

All the engine manufacturers had in common a very high standard in the quality of the finish of their exhibits, and although considerations of space in so comprehensive an exhibition necessarily precluded the inclusion of many of the items which makers would have preferred to show, in many cases the difficulty was surmounted by the use of scale models in transparent plastic—some of them "working."

A pointer towards future activities was given on the Napier stand by a placard showing a turbine/airscrew unit fitted with contra-rotating airscrews. From the appearance of the illustration it would appear that the new unit is to employ a centrifugal compressor. Since the Sabre VII contracts are on the point of completion, and in view of the fact that in the higher-power categories the orthodox piston engine is virtually obsolescent, it is, perhaps, a reasonable assumption that Napier's activities are henceforward to be concentrated exclusively upon the production of gas turbine engines. However, whether this company will direct their energies to developing turbine/airscrew plants, pure jet units or compound engines, or, perhaps, all three, it is as yet too early to hazard a guess. Certainly the successes they have won with establishing the Sabre VII as the highest-powered liquid-cooled engine in the world augurs well for future Napier power units, no matter what form they take.

The Brigand long-range attack machine was another type demonstrated with external loads.

Two Rolls-Royce Nenes, the static thrust rating of which is 5,000lb, are specified for a Vickers Viking project, the expected speed of which is given as 450 m.p.h., whilst another project illustrated on the same stand was the V.C.2 development of the Viking powered with four Rolls-Royce Dart engines. These latter are axial-flow turbine/airscrew units and, although details have not as yet been disclosed, the power rating is generally assumed to be of the order of 1,000 shaft horse-power.

The Armstrong Siddeley Mamba 1,010 s.h.p. axial-flow turbine/airscrew power plant, with its overall cowling diameter of only 27 inches, looks absurdly small in contrast to the bulk we have in the past always associated with such a power category. Here again, although the manufacturers are prohibited from disclosing details, an inspection of the engine gives one to believe that the compressor consists of four or, perhaps five, stages, and that the reduction gear is of the epicyclic type; its reduction ratio we will hazard a guess as being in the neighbourhood of 14:1.

The Alvis Leonides was an impressive example of a complete power plant of low/medium power, the engine itself being remarkable for its cleanliness of design and for the finning arrangement of the cylinder heads. This is so designed that the fins are raked relative to the cylinder axis, and a further noticeable point is that the finning is carried up to surround the exhaust valve placement, whilst the inlet valve position is unfinned.

One of the most interesting aircraft in the exhibition was the Avro Lancastrian fitted with two Rolls-Royce Nenes in place of the usual outboard Merlins. The installation is particularly neat, and although structural alterations were necessitated to allow accommodation of the gas turbines, the actual engine controls are unchanged with the exception that the normal airscrew controls for the outboard engines are, of course, omitted.

The Static Exhibition

It has been said of ship building that it embraces every trade and industry that exists. To-day, the business of building and equipping aircraft has almost, if not quite, reached the same stage—a fact which was soon realized after a walk round the 190 stands in the static exhibition at Radlett.

To house the static section of this exhibition—the biggest of its kind ever held—it was necessary to erect a tent

SEVENTH S.B.A.C. DISPLAY

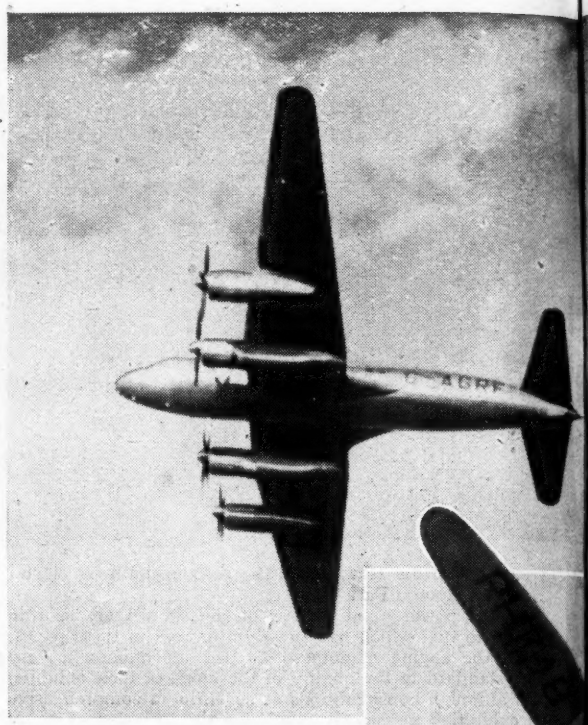
extension to the huge hangar placed at the disposal of the S.B.A.C. by Handley Page, Ltd., and in the wide entrance stood, as a symbol of British achievement in aircraft engineering, the Schneider Trophy.

The main purpose behind this splendid show was, of course, to let the rest of the world see just what the British aircraft industry could do and, to judge by the many foreign tongues one heard when walking from stand to stand, the world-at-large was very well represented there. In point of fact there were, among the foreign visitors, representatives of some 50 nations.

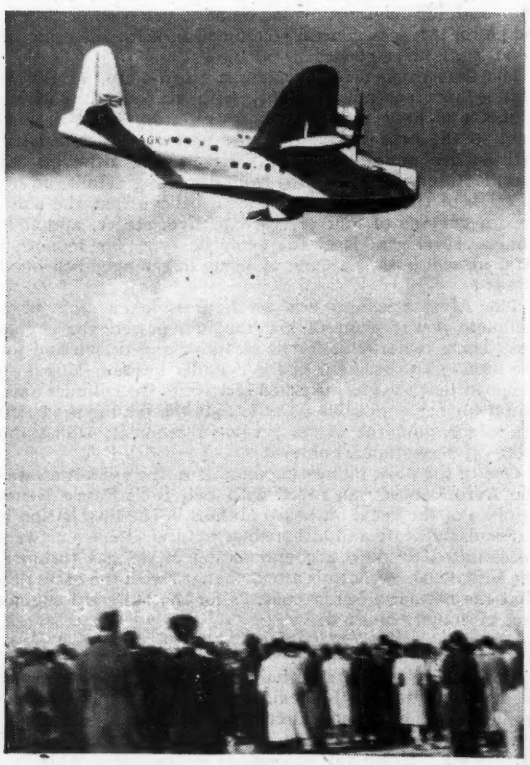
It is possible that an airfield hangar, however spacious, is not the ideal place in which to house nearly 200 exhibitors' stands, but no criticism could reasonably be levelled at the actual result achieved at Radlett. Every exhibitor had patently gone all out to display his products and demonstrate his activities to the best possible advantage, and there was no suggestion of hasty improvization; the scene was reminiscent of Olympia or Earls Court at their brightest and best.

Working Models

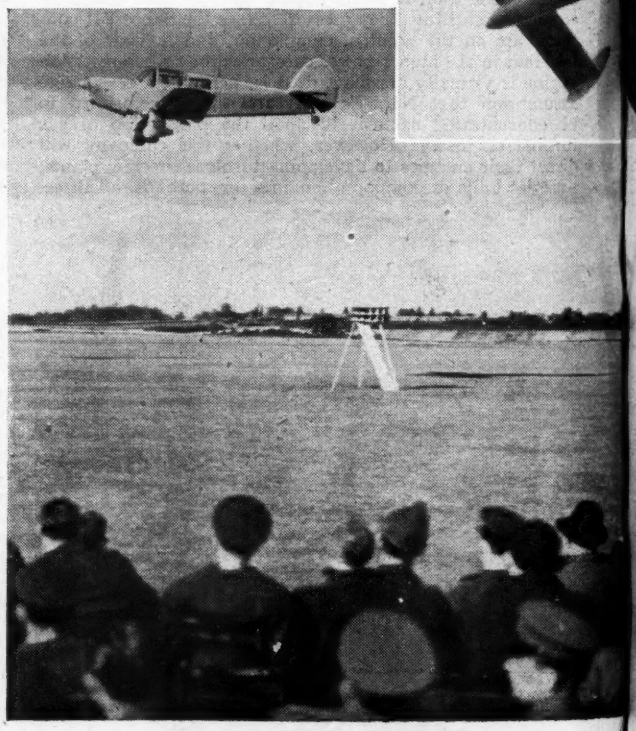
It was only natural that the visitor's attention should be first caught by the glistening engines and other similarly imposing show pieces (especially those magnificent cut-away working models which add movement to colour and so attract the eye), but a systematic inspection soon revealed that the wealth of auxiliaries and ancillaries that go to make up the complete, ready-to-fly, modern aircraft occupy the brains and hands of a very large section indeed of the industry.

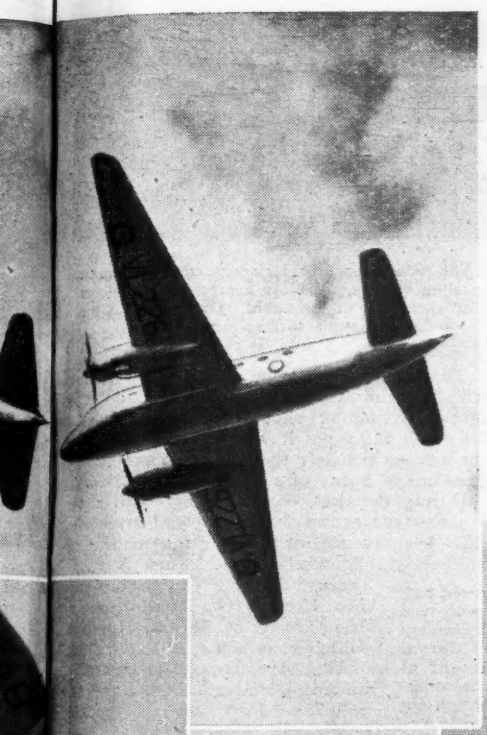


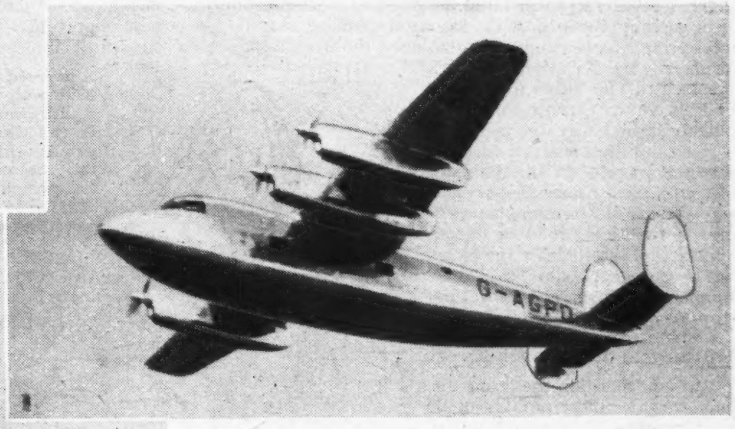
The Tudor I and Viking (top) were amazingly agile. On one Centaurus the Brigand (centre) flew comfortably. The Procter V, Welkin II and Marathon are at lower left, lower right and extreme right, and the Cierva W.9 at top right. All were perfectly displayed.

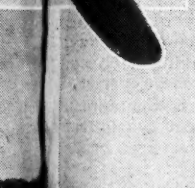


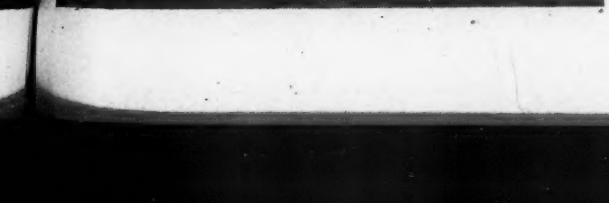
The bright afternoon sun accentuates the hull lines of he Sandringham. On one run its B.O.A.C. pilot demonstrated control with two Pegasus stopped.











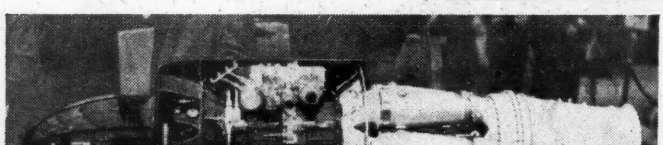
Among the exhibits concerned with the handling of aircraft, a particularly interesting device on show was the Handley Page throttle-box for aircraft fitted with reversible-pitch airscrews. This component is based on the sensible realization that to open the throttles with the normal forward movement of the levers is an unnatural thing to do when the pilot wants to stop his aircraft; sheer habit will make him want to pull them backwards. Thus the H.P. throttle-box is so arranged that to check the aircraft by means of the reversible-pitch airscrews, the pilot, having closed his throttles in the normal way, presses a button on the control column to reverse pitch and then pulls his throttle levers still further back to speed-up his engines again. Should some emergency make it necessary quickly to restore forward urge to the aircraft, all he has to do is to push his throttles forward again in the ordinary way, the pitch being automatically restored to the normal tractor position.

Very many of the stands made use of models in various forms, either to illustrate the actual aircraft being produced, or to be produced in the near future, by the firm concerned, or else to demonstrate the application of some item of equipment. Thus, for example, there was on the Dunlop stand a wing section in Perspex demonstrating their pneumatically operated undercarriage and flap gear. Saunders-Roe attracted considerable attention with a working model of the Gouge system of docking a flying boat, flanked by a wing section showing the action of a retractable wing-tip stabilizing float. Fairey Aircraft made a special feature of their hydraulic servo control system, while the Sperry concern hit upon the excellent notion of

SEVENTH S.B.A.C. DISPLAY

mounting a number of their navigational instruments, such as the gyro artificial horizon and the gyrosyn compass, on the backs of model aircraft set upon ball-socketed pillars.

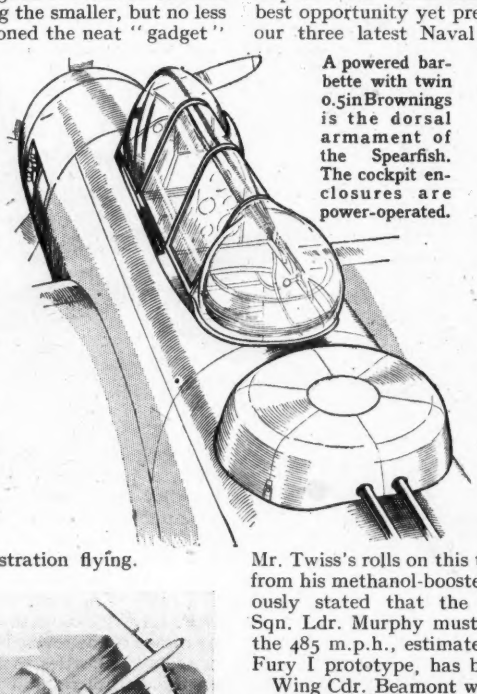
Navigational and other electrical instruments and allied equipment in wide variety formed a large contribution to the display, as did all manner of aircraft furnishings designed to combine comfort with good appearance, while among the smaller, but no less interesting, items, might be mentioned the neat "gadget" displayed by Aviation Developments, Ltd., for either fixing seats or tying down cargo by means of quickly interchangeable fasteners. Other exhibits concerned with the production side of the industry formed a most comprehensive display and ranged from mighty castings down to a bowl of 12,960 minute screws—at least the ticket on the G.K. & N. stand said there were that number, but we did not stop to count them!



The Wayfarer (above) appeared in a smart colour scheme. Visitors appreciated the doors at each end of the cabin. On the left is the new Mamba turbine-airscrew unit.

Military and Research Types

Without question the flying display was the most notable of its kind yet staged in this country. The aircraft were fully representative and, in the main, of recent production, and their pilots were determined to surpass their performances at Farnborough and in other displays which have marked a notable year of demonstration flying.



A powered barbette with twin 0.5in Brownings is the dorsal armament of the Spearfish. The cockpit enclosures are power-operated.

The events can best be described by dealing with the aircraft according to class, and it is proper that fighters should have pride of place, for of all the types it was these—particularly the jets—which left the most memorable impressions of a day of superb flying.

During the dull, cold morning, with a 15 m.p.h. wind across the runway, visitors were given the best opportunity yet presented of assessing the qualities of our three latest Naval fighters—the Sea Fury X (Centaurus), Seafang 32 (Griffon) and Sea Hornet (two Merlin), flown respectively by Messrs. Humble, Lithgow and Pike.

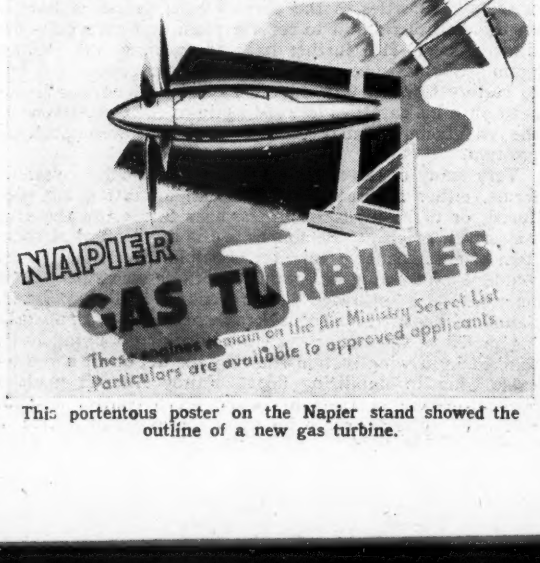
Humble's show was a perfectly smooth blend of climbs, zooms, rolls, wing-tip vortices, rocket loops and inverted flying; the Seafang, untroubled by an inquisitive Dakota and a Harvard, showed that, apart from being the fastest of the Naval fighters, it has exceptional aileron control; and the Hornet proved that on only one Merlin it has ample power for most manœuvres expected of a machine of its class. All three smartly folded their wings during their landing runs.

The Fairey Firefly IV (Griffon)—another deck-landing fighter—established that a properly designed two-seater need lose little in speed and manœuvrability. Mr. Twiss's rolls on this type were a joy. Taking 3,100 h.p. from his methanol-boosted Sabre VII (the announcer erroneously stated that the power plant was a Centaurus), Sqn. Ldr. Murphy must have convinced most people that the 485 m.p.h., estimated by Hawkers as the speed of the Fury I prototype, has been confirmed.

Wing Cdr. Beamont went straight into his frolicsome act on the Vampire. He looped round clouds, darted through the blue gaps and extended his undercarriage while inverted to make a ¼-runway landing.

The Rediffusion having regretfully proclaimed that the Supermarine E.10/44 could not be let all-out (though assuring the audience that it had "a good turn of speed") Mr. Quill proceeded to put up an apparently uninhibited show of speed, climb and upward rolling on this amazing new prototype. It gives the impression of being at least as fast as the Meteor (Supermarines tentatively claim 600 m.p.h.) and it is evidently an aircraft and not the winged projectile it appears to be on first sight. Quill flew it round a tremendous arc, the top several thousand feet high. He had most people on their feet throughout his performance and fully deserved the unstinting praise they accorded him.

Philip Stanbury set out to demonstrate the much-improved rate of roll of the Meteor IV with the new short-span wing. He was, of course, fully successful in this, and in his exposition of the other qualities—speed, short take-



This portentous poster on the Napier stand showed the outline of a new gas turbine.

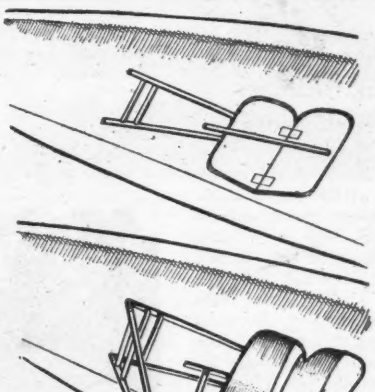
SEVENTH S.B.A.C. DISPLAY

off and high rate of turn possessed by the Meteor in such adequate degree. There is no general-purpose fighter superior to the Meteor and no better exponent of its qualities than Stanbury.

Geoffrey de Havilland, with the second of the two D.H.108 research machines, was rightly reserved for the final event. In recent months he has been flying this delightful aircraft at progressively increasing speeds and has reached the point where he is able to equal, and even to excel, his classic displays with the Vampire. Not only is the 108 unusually fast but is amenable to the most advanced aerobatics, including aileron turns. A turn off the runway immediately after take-off proved that the 108 is tractable at the lower end of its speed range. It now has a metal-strengthened cockpit hood and free slots.

The 70-foot span of the Welkin II made it difficult to appreciate that it is, in fact, a fighter, and, judging from Mr. Penrose's performance, a good one.

Without exception the less spectacular military machines held interest throughout their appearances. The matronly Warwick (Mr. Sutcliffe up) took full advantage of its twin 3,000 h.p. Sabres, particularly on take-off. The deck-landing Spearfish (Twiss) demonstrated the advantages conferred by its ample Youngman flaps, and the aggressive-looking Brigand (Cribb) seemed to lose little in speed and agility due to its external torpedo and R/Ps. The Firebrand V (Lawrence) went smoothly through a programme of low- and high-speed flying and aerobatics with its torpedo in place.



The wing-float on the model of the Saunders-Roe S.R.-45 flying boat is bifurcated and retractable.

"Mossie" Aerobatics

Mr. Walker demonstrated that the long-range record-breaking Mosquito 34 does not shun aerobatics, and Sqn. Ldr. Field-Richards likewise put the massive black-and-white Lincoln through evolutions not generally demanded in service.

Two big military transports—the Hamilcar X power-assisted glider (Wood) and the Hastings (Sanders)—performed in becoming manner. The Hamilcar handled remarkably well after release from its Halifax tug and the Hastings, immediately after take-off, proceeded quickly on two of its four Hercules.

Five trainers—the Buckcaster (Birks), dual-Firefly (Moseley), Martinet (Waller), Desford (French) and Prentice (Carruthers) adequately displayed the qualities of modern instructional aircraft. Waller's machine had full target-towing gear.

Finally, tribute must be paid to the impressive performances of the Nene-Lancaster turbine-jet test bed, which whistled over the crowd at well over 300 m.p.h. on its jets alone, and of the A.W.52G research glider, after casting off from its Whitley tug. Messrs. Shepherd and Franklin, who flew these types, did much to impress on foreign guests that the S.B.A.C. can claim as members some enterprising constructors.

In any long-period display, during which the more exciting military types are in the majority, it is difficult for the demonstrators of civil types to think of new means of maintaining interest. Obviously, civil aircraft must be inspected and flown in, rather than demonstrated, if they are to be properly appreciated. However, the various pilots circumnavigated the difficulty on Friday by proceeding, with a positive burst of variations of what the A.R.B. calls "asymmetric" flying—both while thoroughly airborne and while taking off. Never have so many aircraft flown for so long with so few available engines in action.

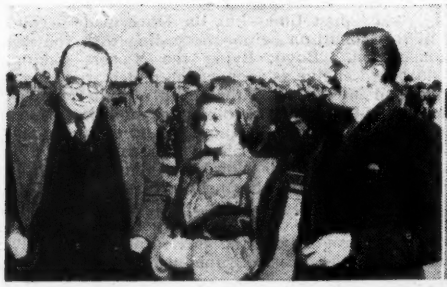
For instance, both Thorne and Sanders, with the Avro Tudor I and the Handley Page Hastings (in place of the civil Hermes) feathered both airscrews on one side and showed off the handling qualities during continuous flying in this lop-sided power condition, while Waller with the Miles Marathon stopped the port outer on take-off and later flew around with two out on one side. The latter, incidentally, was quite impressively flung about the sky. Of the twins, the first to carry out a "cut after take-off" demonstration was Fossett's D.H. Dove. The action was a trifle delayed—because the feathering circuit didn't "take" first time—but the Dove made a complete circuit in this condition before proceeding with the rest of the demonstration. Boyd, flying the Vickers Viking, stopped the starboard engine as soon as the undercarriage was on its way up, and later showed that even a civil transport is not necessarily without near-aerobatic capabilities. Most impressive of all, perhaps, was the show put on by an anonymous B.O.A.C. pilot with the Short Sandringham. Not satisfied with the now familiar slow, low, flaps-out flying, he brought the big boat across the field with the two outers feathered and at much the same slow speed, while "stirring the pot" to produce a mild crazy-flying effect.

First on the day's programme, and carried out in three fly-past operations, was the Flight Refuelling demonstration—and very effective it was. Messrs. Prowse and Jeffrey flew the two Lancasters low in true Hendon-tied-together precision after they had gone away to be linked up for the fuelling, and later broke gently away immediately after crossing Radlett. By way of contrast—and the only truly civil aircraft flown during the morning—the Miles Messenger gave a nice impression of quiet handleability, with its slow flying and short landings and take-off—to be repeated later in the day by the Aerovan and the production Gemini flown by Miles. The latter, after some initial doubt—perhaps after many months of flying with the non-retractable version—finally tucked up its undercarriage. But, in the meantime, it had flown round on one motor with everything down. While the A.W. glider and the Hamilcar near-glider (complete with two Bren gun-carriers) were finally coming in, Marsh took locally to the air with the experimental Cierva W-9 helicopter, making its familiar singing noise as the anti-torque jet compressor did its work. Incidentally and experimentally, the W-9 now has a small fin and rudder.

Civil Civilians

Leading the afternoon contingent, Snarey's Auster Autocrat, after some tight aerobatics of the old-fashioned kind, flew gently and quietly about—but for rather longer than his appointed time—while, later on, Sanderson, with the Percival Proctor V, demonstrated a private-owner-transport type in a somewhat different category. Difficult enough to show off in any unusual way, the Bristol Wayfarer, flown by Pegg, was nevertheless impressive, and joined the other transports in "asymmetric" evolutions, while Clare's Airspeed Consul hung, at one stage, on precisely nothing over the heads of the crowd in a show of good stalling characteristics. Both these aircraft were interesting in their different classes—hampered though the pilots were by the inevitable effect of competing with the more dramatic and demonstrable military types coming before and after in the flying programme.

Mr. Humble folds the wings of the Sea Fury X as he comes to rest after one of the finest aerobatic displays to date.



AT THE PARTY : (Left) F. R. Banks, Mrs. Mynors (Paddy Naismith) and Group Capt. Mynors. (Centre) Air Comdre. McDonald, A.F.C. and Mrs. McDonald. (Right) Capt. and Mrs. Cyril Uwins.

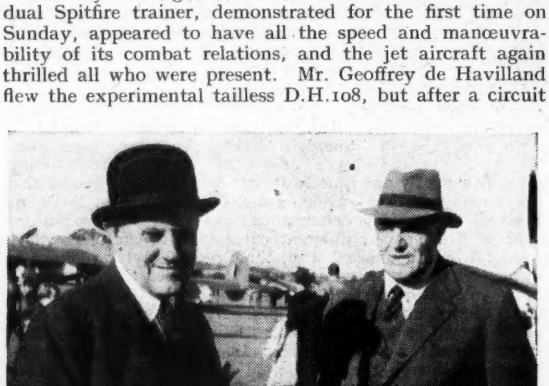
R.Ae.S. Garden Party

Popular Function Held in Brilliant Weather : Flying Thrills Visitors

ON Sunday, September 15th, the Royal Aeronautical Society held their Garden Party at the Radlett airfield by permission of the President, Sir Frederick Handley Page, and members of the Society with their families and friends were able to see most of the aircraft and also the static exhibition arranged by the S.B.A.C.

Bright sunshine, a fine selection of aircraft, and most skilful pilots helped to make the flying display the most spectacular ever seen at an R.Ae.S. garden party. The opening line astern fly-past of large- and medium-size air liners, led by the Hastings and accompanied by a Lincoln heavy bomber, was in contrast with the individual flights of military and light civil aircraft which followed. The dual Spitfire trainer, demonstrated for the first time on Sunday, appeared to have all the speed and manœuvrability of its combat relations, and the jet aircraft again thrilled all who were present. Mr. Geoffrey de Havilland flew the experimental tailless D.H.108, but after a circuit abandoned his demonstration because his undercarriage warning lights remained red. An attempted remedy after landing was unsuccessful, but subsequent inspection showed mud in the micro switch to be the only cause of the trouble.

FAMILY AFFAIR : Lady Buchanan, Dr. Joan Buchanan, F/O. McAuley, Dr. Ian Buchanan and Sir John Buchanan.



TECHNICAL TOPICS : Sir Roy Fedden and Rex Pierson in conversation.

The commercial aircraft each demonstrated their ability to climb and weave with one or two engines feathered. This makes an encouraging sight for air travellers, but may give an optimistic impression of the aircraft's capabilities with a full load. The experimental Lancastrian semi-jet flew past almost as fast on its two Nenes as on four engines. Incidentally, its speed was about 340 m.p.h.

The light aircraft—Proctor, Gemini and Desford—followed by Meteor and Nene Lancastrian, needed to concentrate their flying over the marquees so that the large crowds queueing for tea could see them, and the highly patriotic, encyclopædic and sometimes inaccurate commentary flowing from the loudspeakers was lost to all but the few guests remaining on the tarmac.

WATCHING THE FLYING : (Left) Lord Brabazon watches the Vampire perform. (Centre) Sir Frederick Handley Page, who opened the Garden Party, with Peter Masefield and Major Stephen Masefield. (Right) Mr. and Mrs. Peter de Havilland find the sun a trifle bright.

CIVIL AVIATION NEWS

Proposed Unused Ticket Charges : Dominions' Pacific Agreement : A New Hangar

PRE-WAR DESIGN. The terminal building at Collinstown Airport, Southern Ireland.

THE P.I.C.A.O. DEMONSTRATIONS

THE P.I.C.A.O. delegates are visiting the three R.A.F. Stations at Bassingbourn, Malvern and Farnborough, and, in addition, visits have been arranged to several well-known commercial firms making radio and other equipment. The demonstration of air traffic control systems at Bassingbourn is described elsewhere in this issue.

R.A.F. Transport Command have set out, in a simple demonstrative manner, the exhibits, and the delegates should be able to obtain all the necessary information from the demonstrators, all of whom have had personal experience of their operation. Much of the equipment which will be shown for the first time is identical to that used by the operational commands during the war. The delegates will fly in Dakotas which have been specially prepared for demonstrating the equipment. Passengers are seated looking forward at the operators, who, with the aid of a microphone, demonstrate how each individual item is used.

It is not a show of new gadgets but of old and well-known devices, all of which can be applied to civil aviation. Undoubtedly radar will contribute very largely to the solution of the problem of making the fullest possible use of air space in the immediate vicinity of airfields and on the approach lanes.

B.E.A.C. MOBILE REPAIR UNITS

IN *Flight* of August 29th we mentioned that two Bristol Freighters were being rigged out as flying workshops for B.E.A.C. Several erroneous statements have been made about these two special aircraft, for it is understood that there is no intention by the Corporation for setting aside two special aircraft for the purpose of emergency maintenance and repairs. It is true that certain equipment is under consideration for installation in any Bristol Freighter that might be available at the time of need. This equipment is essentially mobile and capable of rapid installation, and as the aircraft would be perfectly standard, there is no question of any special allocation for a flying workshop. It is well-known that such a luxury would not be an economic proposition.

CARIBBEAN AIRPORTS

THE following British airports in the Caribbean area are among 108 which have been recommended by the Washington Conference for international use as terminal or alternative airfields: Nassau (Bahamas), Barbadoes, British Guiana, British Honduras, Antigua, Jamaica, Leeward Islands, Trinidad and Windward Islands.

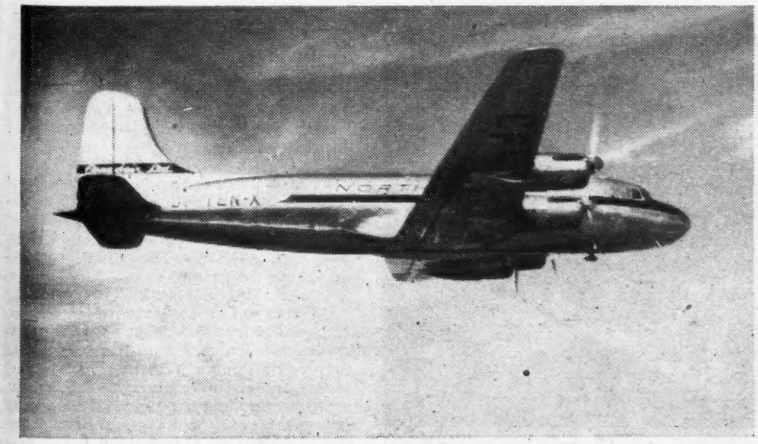
The conference also recommend that 32 airports in the United States should also be made available. The submission of the list paves the way for a speed-up of work by the committees concerned with air traffic control, meteorology, communications, search and rescue, and the other facilities which must be located for the internationally used airports.

AIRLINE DEPOSITS

THE North Atlantic Traffic Conference of I.A.T.A. have approved service charges to discourage passengers from wasting precious space in aircraft by failing to occupy booked seats. The vote by the airlines concerned in the service between Europe and North America is subject to the approval of their respective Government authorities.

The proposal is for a charge of 25 per cent, with a $50 maximum, on refunds for unused tickets which are not cancelled before take-off. On the transatlantic route, seats which are unused lose their entire value since there is no opportunity for picking up further passengers until the longest part of the flight has been completed, and in the present circumstances of tight bookings a vacant seat means that someone who might otherwise have used the seat has been deprived of their chance of making the journey. The service charge will become effective fifteen days after all Government authorities concerned have approved the measure.

The conference also adopted a standard table of great circle mileages between transatlantic route points to be used by all members in computing rates and tariffs. The standard mileage for the great circle non-stop distance between New York and London is estimated as 3,341 miles. For the purposes of this computation the distance from New York to other points in Europe were as follows: Copenhagen, 3,842 miles; Amsterdam, 3,633; Brussels, 3,655; Lisbon, 3,360; Oslo, 3,672, Stockholm, 3,915; and Paris, 3,623. The mileage basis used is the total of the great circle distances between stops on the route; thus, the price of a ticket from New York to Stockholm is based upon the accumulated great circle mileages from New York to Gander, Gander to Shannon, and Shannon to Stockholm.



ANGLO-AMERICAN: The Douglas D.C 4ms., which have the new Rolls-Royce Merlin series 620 power plants, are now in service with Trans-Canada Air Lines.

CIVIL AVIATION NEWS

K.L.M. GESTURE

MAJ. GEN. R. E. URQUHART, the Commander of the First British Airborne Division which took part in the Arnhem action, yesterday christened, at Schiphol Airport, the first K.L.M. Constellation which had been delivered to the company. The aircraft was named the *City of Arnhem*, and carries both the crest of the city and also that of the Airborne Division. On Monday, September 9th, a K.L.M. Constellation landed at Schiphol Airport at 09.20 hrs., having made the crossing from New York in 13 hrs 31 min.

JOINT PACIFIC SERVICE

A BILATERAL agreement has been concluded between Canada and Australia for the start of the air service between Sydney and Vancouver, via San Francisco. Australian National Airways will commence the service and the fare will be the same as if travelling via Tasman Empire Airways and Pan American Airways.

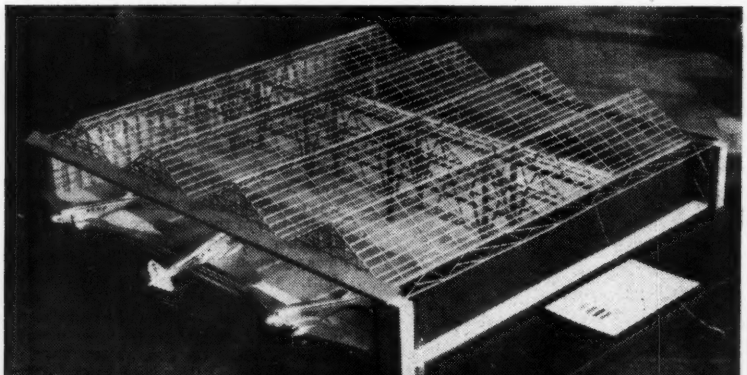
Under the agreement both Canada and Australia may run services between Sydney and Vancouver, and the traffic is to be divided equally. Each has the right to use all airports, airways and other facilities provided by the parties for use by international services on specified routes.

NEW HANGAR DESIGN

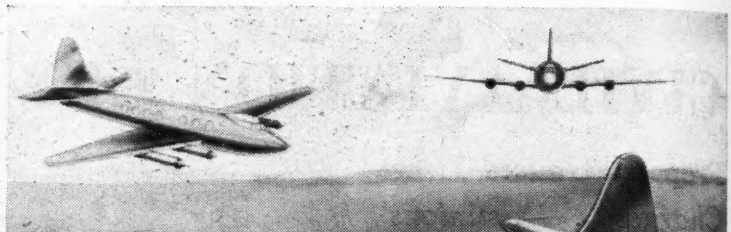
MR. CHRISTOPHER NICHOLSON, M.A., the consulting architect to B.E.A.C., and Mr. Felix J. Samuely, B.Sc., have designed jointly a hangar of unusual construction. A heavy steel structure forms the central portion and support along the length of the hangar. In this central building are housed, on the ground floor workshops, the central floor offices, and on the top floor a canteen or other offices. From this is arranged a light steel cantilever construction radiating outwards, making a total span of 234 ft, included in which is the 20 ft width of the central building. At the extremes of the cantilever construction, Esavian type electrically operated folding doors complete the building. The doors are 157 ft 6 in long and allow a clear opening up to 270 ft in any required portion of the side. Aircraft are placed nose or tail inwards at the side of the hangar, as opposed to the normal way of wheeling aircraft into the ends.

The advantages of this construction are that any length of hangar may be built and additions easily made. Also the very wide opening of the doors will permit aircraft of large wing span to enter at any place that is desired.

A model of this hangar was to be seen on the Esavian stand at the S.B.A.C. exhibition at Radlett.



HANGAR MODEL : A photograph of the model showing the construction which is cantilevered out to obtain space clear of obstruction.



THE V.C.2 : Designed to the Brabazon IIb requirements this Vickers aircraft will be powered by four R.R. Dart airscrew turbine engines.

FROM THE CLUBS

The Herts and Essex Aero Club now have three full-time instructors in addition to one part-time instructor. Incidentally, the C.I., Mr. T. H. Cather, has put in an hourage figure which must be by way of being almost a record for a pilot of the age of 27; he has completed 5,500 hours, mostly on instructional flying. The club has recently obtained some Tiger Moths from the M. of S. disposals, and the workshops will be busy during the winter on the job of making them airworthy.

BREVITIES

B.E.A.C. have just completed a successful proving flight from the United Kingdom to Ankara and return. The captain of the aircraft was Capt. J. W. G. James, B.E.A.C.'s chief pilot. Travelling in it were Mr. G. D'Erlanger, the managing director, and Mr. R. C. Morgan, the chief project and development engineer. One of the objects of the trip was that of checking the operation of the aircraft and power units in semi-tropical conditions.

* * *

Norwegian Airlines (D.N.L.) have ordered three 37-seater Short Sandringhams for the coastal Oslo-Kirkenes service. At the same time, Shorts have also received an order for four Sealand amphibians from another Norwegian operator—Vingtor Luftveiver.

* * *

One of the twelve Halton class airliners ordered by B.O.A.C. has been named *Falaise* to commemorate the elimination of that enemy pocket during the liberation of France. The Haltons will be used on routes between the United Kingdom, Egypt, India and West Africa.

* * *

Following the order by Indian National Airways of six Vickers Viking IBs, this airline company has now placed an order for two Bristol Wayfarers, which will be put into operation on their services during the next month.

* * *

At the end of last month an Indian National Airways DC-3 left Delhi to survey the India-Akyab-Rangoon route in preparation for a regular Burma service. Interestingly enough, I.N.A. aircraft were among the last civil transports to operate out of Rangoon during the war. In the meantime, the company's Delhi-Madras service has been taken over by Deccan Airways.

AIR TRAFFIC CONTROL

The Demonstrations at Bassingbourn : Two Suggested Control Schemes : Individual Navigational Aids Described

THE visiting delegates of the Provisional International Civil Aviation Organization are being shown at the R.A.F. Station, Bassingbourn, two schemes for the ground control of air traffic. The items of equipment on which both schemes depend are being exhibited separately with suitable working mock-ups, and the R.A.F. have taken the opportunity of showing several other recognized aids to navigation which could be used as the basis for other possible methods of control.

The Ministry of Civil Aviation and the R.A.F. have quite different systems which, however, are similar in their common dependence upon radar and radio, air discipline, and accurate flying. Both systems are new to civil aviation, but the R.A.F. Transport Command have experienced considerable operational success in the Far East with the Service method. Although the civil scheme has not been tried operationally, Gee, upon which it depends, is a tried and proved navigational aid. In fact, all the radar equipment is very similar to that used so successfully by the operational commands during the war and is invaluable in its resistance to interference from static. Exercises are continually being flown, and we were recently given the opportunity of witnessing complete and highly successful demonstrations of both systems.

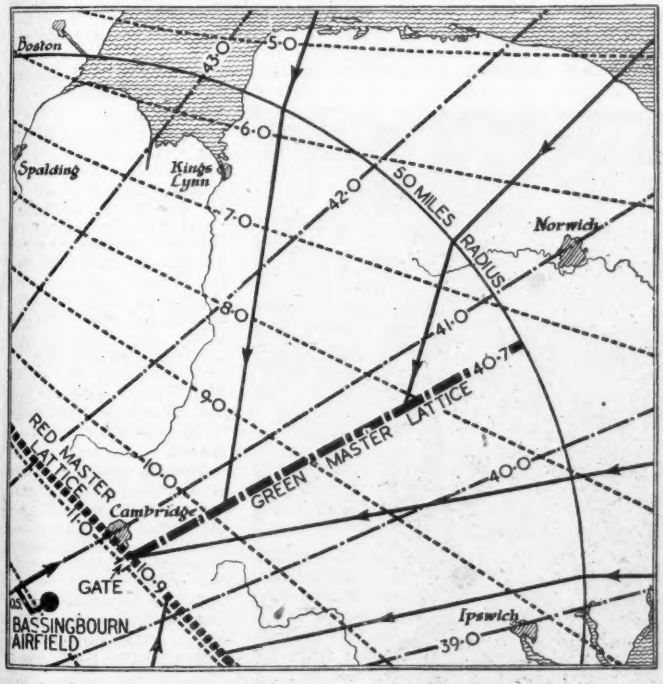
Below is a description of the two schemes, and also, very briefly, of the equipment which is demonstrated and on exhibition. An interesting feature in both systems is the fact that the aircraft, while awaiting landing instructions, are "stacked" horizontally, a method which has many advantages over vertical separation in those parts of the world where icing may be heavy.

The Ministry of Civil Aviation's air traffic control scheme depends primarily on the use of Gee, the principles of which are described later. Although a special Gee pattern is not necessary, it is a prerequisite that within a radius of 50 miles from the airfield the hyperbolae are as nearly straight as possible and cross at approximately 90 deg. For each direction of approach two Master lattice lines are selected to cross 8 miles downwind of the runway; this position is called the "gate," and it is at the "gate" that the traffic control system ceases, and the aircraft is then dependent upon preselected approach systems.

When about 70 miles from the airfield, the aircraft sends a W/T message with its position and time at which it expects to leave Area Control and to enter Approach Control—which starts within a radius of 50 miles of the airfield. The Controller then decides, with the knowledge of other aircraft movements, air speeds and wind velocity, the course which shall be flown by the aircraft to reach the "gate." If no other aircraft are approaching the gate, then a direct line can be ordered, but if some delay is necessary in order to allow other aircraft through, a computed course is ordered so as to bring the aircraft on to one of the Master lattice lines, maintaining in both cases a height of 2,000 feet. On reaching the Master lattice line, the aircraft homes along it to the gate. The Controller arranges passage for each aircraft through the gate in such a way as to permit landing in a steady flow and, at present, at an interval of three minutes, which also permits take-offs between landings. R/T is used where language permits, but W/T is possible.

If for any reason an overshoot is necessary, the aircraft turns to starboard through 180 deg. on to a lattice line parallel to the approach lattice, and continues at 1,000ft until reaching the crossing Master lattice, when a signal must be sent to Control. The Controller then decides when the aircraft shall turn on to the approach lattice.

The Ministry intends to use Airfield Control Radar in conjunction with the scheme to enable the Controller to maintain a complete picture of the horizontal position of all aircraft within his control area.



M.C.A. DEMONSTRATION AIR TERMINAL: If landing at Bassingbourn in the direction 260° M. aircraft would be routed either direct or on to one of the master lattices to reach the "gate." Only whole-number hyperbolae are shown in this diagram.

R.A.F. Poor Visibility Landing System

The R.A.F. system of controlled landing for aircraft in poor visibility has the advantage of being mobile. On any airfield where an Eureka beacon may be put down and a Babs van placed in position, then the system may be worked with aircraft carrying an orbit meter and the necessary Rebecca apparatus. All four of these items are individually described later.

Although this system has been evolved to meet military requirements, it may be applied to solve similar problems in the control of civil air traffic.

The requirements for operating the scheme are, first of all, an Eureka beacon, around which aircraft can orbit at given or preselected radii. Secondly, each aircraft must carry an orbit meter to ensure accurate flying on the circular track around the airfield. A Rebecca must also be carried to operate the orbit meter and to interrogate Babs for the beam approach. The sequence of events is standard and direction from the ground is very simple. Aircraft

AIR TRAFFIC CONTROL

are directed into the Babs approach by completing one of two manœuvres.

The aircraft is handed over from Area Control to Approach Control when more than 50 miles from the airfield, and identifies itself. Approach Control pass the usual weather and airfield condition in "Q" code while the aircraft maintains quadrantal height and passes its true air speed to control. The direction from which the aircraft is approaching is indicated on the cathode-ray direction finder, and is checked by the aircraft's own estimate of its magnetic track.

While the aircraft continues to home on the Eureka beacon at 2,000ft, the Controller applies the air speed and wind velocity to the computor, and starts the time-recording of the aircraft in order to check its ground speed. From the data the Controller is able to plan the landing of the aircraft to fit in with others approaching and landing, and if a delay is necessary the aircraft is ordered to orbit the airfield at a given radius. The pilot then joins the orbit, flying on his indicator at 1,500ft until, when within the Babs zone he transfers to the beam approach.

The alternative manœuvre is for the aircraft to be given a *cross-over* entry into its orbit; this means that, instead of turning right directly on to the orbit, it overflies the airfield centre and then makes a left-hand procedure turn on to the orbit.

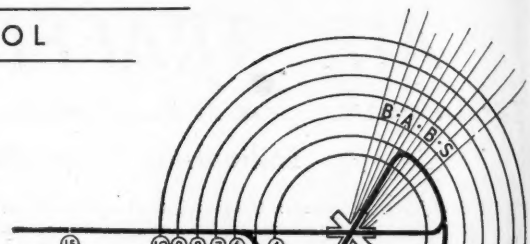
Overshoot is quite simple, and merely requires that the aircraft rejoins the orbit at 1,000ft in a left-hand turn.

Airfield Control Radar once again, when used with this scheme, gives the operator a complete plan-picture of the situation in the area under his control.

THE EQUIPMENT

Apart from the essential W/T and R/T sets the airborne equipment necessary for the M.C.A. system is a Gee set only. The Ministry favour S.C.S.51 for blind approach and this, with Gee, is briefly described below.

Gee is a system of radio position-finding which can be used by an unlimited number of aircraft simultaneously. A network of stations already exists in Europe and along the trunk routes to the Far East. Three ground stations are situated about 70 miles apart and radiate a steady succession of pulses



R.A.F. SYSTEM. The thick line shows a typical path of direct entry and crossover entry on to orbit 5.

which are received in the aircraft and displayed on a cathode-ray indicator. The time interval between the arrival of a pulse from the central or master station and a pulse from each of the slave stations is measured on this indicator; hence the lines of position generated by each pair of stations are hyperbolæ with the stations at foci. The measurements are presented to the navigator on the cathode-ray tube in the form of a "blip" on a scale.

Two stations are required for a position line and three for obtaining a fix. The range of the system is 200 miles at 5,000ft and is highly accurate, and, apart from its value as a navigational system, Gee is particularly suitable as a traffic control aid. Multiple parallel tracks may be provided, enabling a means of holding aircraft in known traffic patterns.

S.C.S.51

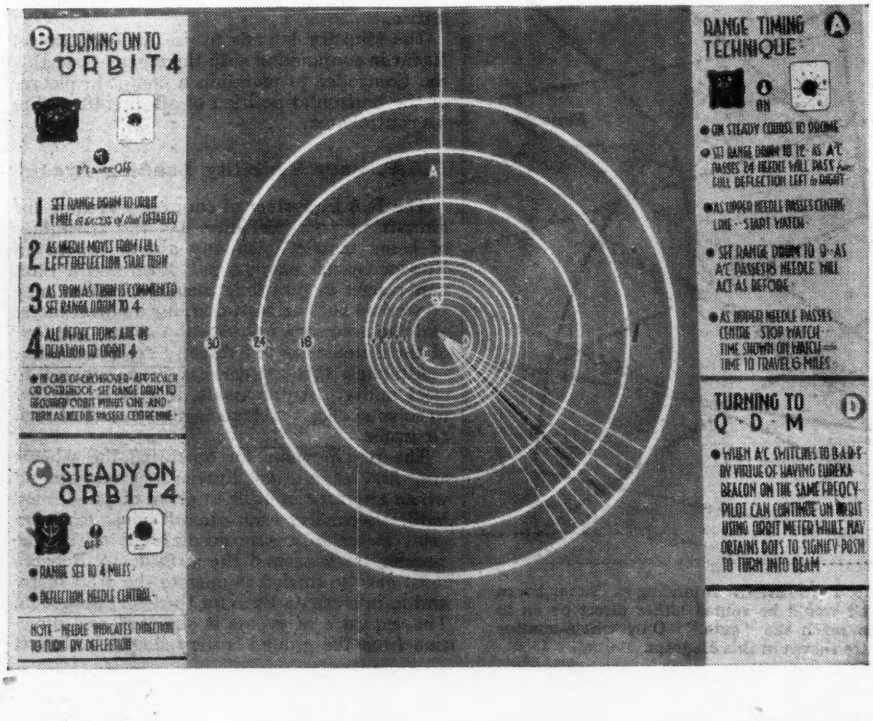
S.C.S.51 is an instrument landing system which uses modulated continuous waves. Three separate components comprise the ground equipment. The "localizer" tells the pilot whether he is to the left or right of the line of the runway. The "glide-path" indicates errors in elevation from the correct approach path, and a series of marker beacons, usually two, give warning that the aircraft is passing over specified points on the approach. Presentation to the pilot is through a special receiver and a double-needle indicator. A vertical needle indicates a turn to the left or right and a horizontal needle indicates necessary corrections in height. A red light flashes on the pilot's dashboard to indicate that he is passing over a marker beacon.

REBECCA

For the R.A.F. scheme the main airborne equipment is Rebecca, which is a short-distance aid to navigation, operating on a radar pulse principle, in conjunction with an omni-directional repeating beacon known as Eureka. The equipment measures accurately the distance from the beacon and allows a rough estimation of the bearing of the aircraft's heading to the beacon. Range is of the order of 95 miles at 10,000ft.

BABS

Babs is really a special development of Rebecca for approach aid. Instead of radiating omni-directionally, a special beacon is located at the up-wind end of the runway in use and re-transmits short-duration pulses on the one side and long-duration pulses on the other side of


B TURNING ON TO ORBIT 4
1 SET RANGE DRUM TO ORBIT
2 AS NEEDLE MOVES FROM FULL LEFT DEFLECTION START TURN
3 AS SOON AS TURN IS COMMENCED SET RANGE DRUM TO 4
4 ALL DEFLECTIONS ARE IN RELATION TO ORBIT 4
C STEADY ON ORBIT 4
RANGE SET TO 4 MILES
DEFLECTION NEEDLE CENTRAL
NOTE - NEEDLE INDICATES DIRECTION TO TURN ON DEFLECTION
RANGE TIMING TECHNIQUE A
ON STEADY COURSE TO BEACON
AS BOBBER NEEDLE PASSES CENTRE - STOP WATCH - TIME SHOWN ON WATCH = TIME TO TRAVEL 6 MILES
TURNING TO Q·D·M D
WHEN A/C SWITCHES TO BABS BY VIRTUE OF HAVING EUREKA BEACON ON THE SAME FREQCY PILOT CAN CONTINUE ON ORBIT USING ORBIT METER WHILE NAV OBTAINS DOPS TO SIGHT & PUSH TO TURN INTO BEAM

ORBIT TECHNIQUE The process of approaching and joining the orbit of an airfield.

AIR TRAFFIC CONTROL

the runway. The navigator measures the distance as before on the Rebecca set, but ascertains the position of the aircraft relative to the correct approach path by comparing the amplitude ratio of short- to long-duration pulses received.

THE ORBIT METER

This is an attachment to Rebecca which enables aircraft to circle a Eureka beacon at selected radii. The pilot selects the radius of the orbit which he intends to fly and the dash-board instrument indicates whether the aircraft is inside or outside that selected orbit. The instrument also shows the distance in miles from the Eureka beacon.

The remaining radar and radio equipment on exhibition consisted of the following:—

G.C.A.

Ground Controlled Approach is a runway approach system in which all the radar equipment is positioned on the ground and the aircraft requires nothing more than good two-way R/T. The ground equipment is mobile and contains two radar instruments and a wide choice of R/T channels. The first radar is called the "search" system, and displays on two cathode-ray tubes the radar location of all aircraft within 25 miles' horizontal distance. The second is the precision radar system and displays on cathode ray tubes the instantaneous plan and elevation position of a single aircraft approaching the runway concerned. Sub-controllers watch the tubes and a traffic director marshals the aircraft by telling each pilot the courses to fly to position the aircraft for the approach to the runway in use. The approach controller uses the information provided by the sub-controllers to guide the aircraft on to the correct approach and to watch for any departure from that approach. Several aircraft may be controlled simultaneously by the traffic director, but only one aircraft can be handled at one time by the approach controller.

This system was described in detail in *Flight* of July 11th this year.

CONSOL

Consol provides long-distance navigational aid for aircraft, using automatic transmitting beacons on the ground and a standard M.F. receiver in the aircraft. The range is about 1,500 miles over the sea and 1,000 miles over land. The system radiates dot and dash signals and a position-line can be determined by making a count of the dot and characters heard during the transmission cycle. The complete cycle of operation takes one minute. During the first twenty-eight seconds an omni-directional characteristic transmission takes place. After a break of 1½ secs the keying cycle of 60 dot and dash characters commences. The cycle takes 30 secs, which is followed by a break in transmission for half a second, after which the cycle restarts. The total operation involves tuning the receiver to the ground beacon, identifying the station code, taking a bearing with D/F loop, if necessary making dot and dash counts, and then referring to the chart. The observer can establish his position by reference to two independently operated Consol beacons, and the advantages are that a position-fixing service is always available without the need for carrying special equipment in the aircraft.

THE AUTOMATIC RADIO COMPASS

The function of a radio compass is to present a continuous indication of the bearing of a known transmitting station with respect to the heading of an aircraft. By linking the indicator with the D/R compass it is possible to obtain the true bearing of the transmitter from the aircraft; thus, by taking bearings of two or more stations it is possible to obtain a fix. The equipment consist of a normal medium-frequency loop and receiver, together with a device which automatically points the loop towards any transmitter to which the receiver is tuned. Continuous-wave beacons are provided for homing purposes at most airfields, and specially placed beacons, usually of higher power than those for airfield homing, are used for navigational purposes.

Flying-Track Control

New Development of Decca Navigator System : Flight Control Up to Landing Approach

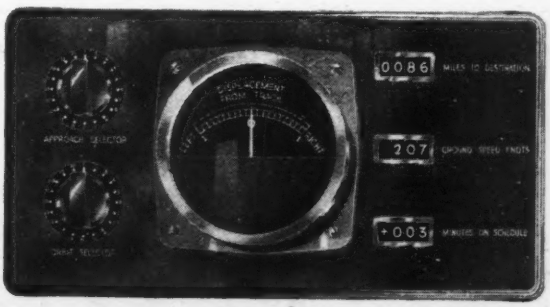
IT has long been realized that the future traffic densities on air routes—particularly those of short and medium distance in highly populated areas—are likely to be such that a saturation point will quickly be reached where traffic control of the aircraft using the routes cannot cope with a greater number of aircraft movements whilst maintaining the minimum requirements of safety. Particularly is this position aggravated in the vicinity of terminal and major junction airports where poor weather conditions might necessitate arriving aircraft being told to orbit until they can be called in to land.

Such a state of affairs already exists in America, where traffic densities are higher than ours at present. Alternative airports where clear conditions exist is not a tenable answer. It affords an escape in extreme conditions, but it is an answer that nobody wants to accept since it ruptures all possibility of schedule-keeping and negatives passenger convenience. This is but one of the many problems which face air transport authorities and planning commissions, but it is the one which particularly interests us here in giving an appraisal of the Decca Navigator Track Control Unit.

The Decca Navigator System was described in the September 13th, 1945, issue of *Flight* and, as many of our readers will be aware, is a navigational aid whereby instantaneous and accurate position-fixing is made possible by the constant emission of long-wave radio signals along hyperbolic lanes from established ground stations. Throughout a flight, readings given on special indicators give the fix of position when referred to an appropriate chart. This permits navigation to be carried out in such a way that the aircraft is free to follow any desired track intended to bring it to its required destination. Whilst this technique permits the lateral dispersion of aircraft, and so reduces the chance of saturating any area, it involves the determination of position by reading certain instruments, of plotting this position on a chart and maintaining a proper air plot.

In examining this problem the Decca Navigator Company reached the conclusion that while the hyperbolic systems, of which Decca is one example, provide a very useful flexibility and freedom of lateral dispersion, they fall short of meeting the fundamental requirements for future air-route operation. The new Decca Track Control Unit removes these limitations and opens up an entirely new field. It is the invention of Mr. R. Calvert, technical director of the Wayne-Kerr Laboratories, New Malden, who are undertaking its development on behalf of the Decca Navigator Company.

The Decca Navigator normally displays the co-ordinates



Pilot's panel for Track Control Unit. Selectors for orbiting and landing approach tracks are at left, and meters for distance and destination, ground speed, and schedule keeping at right. The central indicator is for maintaining the track flight path.

FLYING-TRACK CONTROL

of the aircraft's position on three indicator dials, the readings of any two of which, when plotted on a special chart, fix the position of the aircraft. Thus for any flight a list of values of the indicator readings could be compiled and the flight made by flying in such a manner that the two indicators read, in turn, all the tabulated values.

Such a method would be possible but extremely complex. The Track Control Unit, however, does this automatically. A film record is made which bears all the values of the various fixes for the intended flight. Before take-off this film is inserted in the unit. During flight the movement of the film is controlled by the Decca Navigator receiver, and the fixes obtained from the receiver automatically compared with those recorded on the film. The results are displayed to the pilot on a set of instruments which tell him: (i) Position with respect to track. "On track" is the centre position of the pointer of the left-right indicator, displacement to left or right being shown in miles. (ii) Distance in miles along track to destination. (iii) Ground speed of aircraft. (iv) Minutes ahead of or behind schedule for flight.

Flying any standard route—that is, one for which a track film has been plotted—all the pilot has to do is merely to keep the left-right indicator at zero, and watch his progress along track being registered by the distance meter. If he is making too great or too small a ground speed he is immediately advised of this by both the ground speed meter and the schedule meter. The track can, therefore, be followed with precision both of position and timing. Should bad weather be encountered and a detour be advisable, the pilot has complete freedom of movement, moderate detours of up to 10 miles being possible on the left-right indicator whilst, should a greater diversion be essential, normal Decca fixes are available and the original track can be rejoined when required.

Since the track is defined merely by the film record, it may have any required shape and, additionally, any number of parallel tracks can be laid down between any two points. Thus not only can traffic be accurately directed along any particular track with precision of timing, but dense traffic can be spread over any number of tracks laid out to ensure maximum safety of flight.

Most important of all the Track Control Unit features are those it makes available for traffic control at the airport. Since the track is defined by the film record, any film track can end with any number of standard approaches to the airport destination, and these approaches may be any shape and can be determined by considerations of local topography, runway layout and traffic conditions.

In exactly the same way, a variety of orbiting circuits —again of any desired shape and size and about any number of points—can be defined on the film track. Five minutes before arrival at the fringe of the airport control zone the pilot will ask Control for an approach track. Ground Control, with their knowledge of runway in use, traffic conditions and weather, will, if everything is clear, allocate an approach and designate it by an appropriate reference number. The Track Control Unit has an approach selector bearing the reference numbers and, upon one being given him, the pilot turns the selector to the number allocated and then flies on the left-right indicator, again keeping the pointer central. This track will bring him into a position for landing by visual or other aids.

Should it be necessary, however, to delay the aircraft landing, then the Ground Control will give the pilot an orbit reference number. This number is selected on the orbit selector, and the orbit is then flown on the left-right needle similarly to normal track flight and approach flight. When Control are ready for the aircraft to land, the pilot is told the approach track number; he selects it, and, as before, this brings him into his landing approach.

It is impossible in the space we have available to cover all the possibilities that this new development opens up. The cardinal point to be stressed is that of flexibility. The entire sky can be mapped with tracks of any shape and, as the tracks are in no way related to the layout of the radio system, but are merely film recordings, they can be modified or added to at any time. Furthermore, the film can carry many other data relative to flight along any track, including height of ground above sea level and proximity of any hazards. Finally, it can feed its information to an auto-pilot.

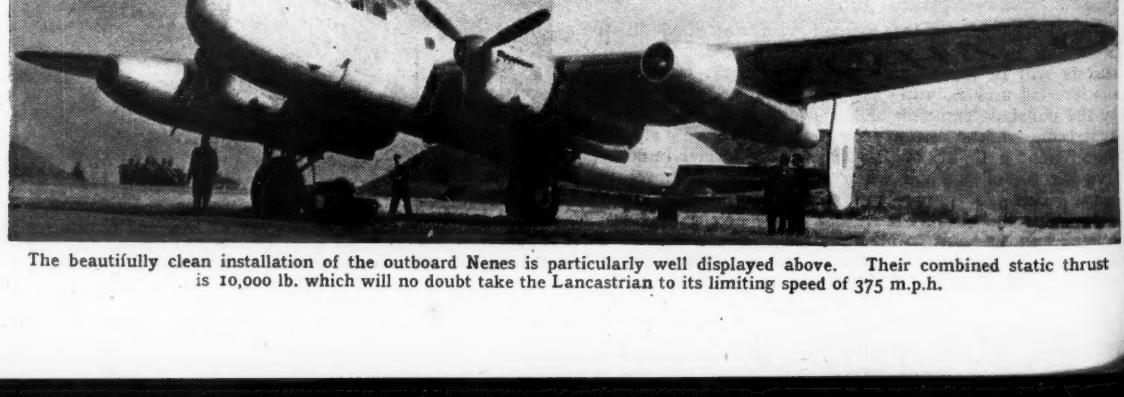
The Nene-Lancastrian

ROLLS-ROYCE, LTD., are making experimental flights with a Lancastrian powered with two of their Nene turbine-jet units and two Merlins. The Nenes replace the two outboard Merlins and make an extremely neat and clean installation, reminiscent of the Gloster Meteor with long nacelles. The experiment is part of the programme of power plant development which is continuously in progress at the Rolls-Royce Hucknall division under contract with the Ministry of Supply.

The objectives are two-fold: first, to assess the efficiency of the power plant under flight conditions, and secondly, to investigate the performance of jet units when installed in heavy aircraft. Results will be checked against estimated performance and the possibilities of jet propulsion for large and medium size transport aircraft will be determined.

The installation of the Nenes in the Lancastrian has necessitated modification to the wing, main spar, flaps and ailerons, and to the power-plant control runs from the inboard to the outboard units. The work entailed has been done at Rolls-Royce and the modifications have been approved by A. V. Roe and Co., Ltd.

An extremely comprehensive range of technical apparatus has been installed. Instruments for both piston engines and jet units have had to be provided as well as many special instruments for purposes of research. At one end of the navigator's table is a panel carrying some 35 different instruments to indicate the slightest variation in power plant behaviour and enable performance and efficiency to be assessed.



The beautifully clean installation of the outboard Nenes is particularly well displayed above. Their combined static thrust is 10,000 lb. which will no doubt take the Lancastrian to its limiting speed of 375 m.p.h.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

R.A.F. SLANG

When Halton Life Was IRKsome!

A FEW months ago you published a letter from my erudite pen in which I settled for ever the controversy concerning the origin of the word "gen." It was invented at Halton and is short for "genuine." Now at that time the life of an aircraft apprentice was very irksome indeed. We didn't get Horlicks for supper as they do now. In fact we didn't get any supper at all, unless one was rich enough to dine in the Naafi. (I, personally, was one of the plutocrats as I ran an illicit barber's shop—threepence for a clip up to the brim of the cap, no credit given, and patronised by the squadron sergeant-major).

As I said, our life was very irksome and whilst going about the barrack room chores one would often hear the saying, "Join the Navy and see the world—Join the Air Force and scrub it." I say again, life was very *irksome*, and *that*, Mr. Editor, sub-editors, correspondents, members of the flying services and all who couldn't care less anyway, is the derivation of the word irk, not erk.

Ah, those were the days of wooden aircraft and iron irks.

L. W. CRAWFORD
(Ex-Irk).

[R.A.F. slang, no less than any other form of expression, is apt to suffer corruption with the passage of time.—ED].

"MATELOT ERKS," TOO

Final Word for the Pilots

AS your correspondent D S. Papworth (*Flight*, August 29th) writes terminating the correspondence on "Tributes," I would like to make it square all round by a final "off caps" to *our* aircrew.

The Fleet Air Arm did a grand job of work in all theatres, usually with out-of-date kites, but with pilots who were top line in every respect. I was with the Barra's when they first sailed into the Japs, defying Zeros and any other junk they put up against us.

Yes, the "matelot erks" did *their* job, but it was the pilots who really had the rough.

Regards to all *Illustrious'* 847 lads, and 733 in Ceylon.

M. N. TAYLER.
(ex-L/A.M.(E.)).

TRIBUTE TO "JOE ERK"

Another "Thank You" to the "Flying Types"

I WOULD be grateful if you could find space to publish this letter as I think it expresses roughly what quite a few of us have felt—it is late because I have only just received my copy of *Flight* for July 25th.

A. J. C. Proctor touched a soft spot in the hearts of many in his letter in *Flight*, July 25th. I was just an "erk," but I'm glad to say that at times I was in very good contact with "flying types" of ranks up to squadron leader. It was that contact which so often encouraged us to do the job cheerfully when we felt least like it.

One of the best pals I ever had was the pilot of my machine —I say "my machine" because after eight months of D.I.s the relationship was quite personal. He was not above giving me a hand. I remember many occasions seeing him in his shirt sleeves cleaning the fuselage and wings—an officer and a gentleman who knew we were all in it together and that some were worked harder than others. More's the shame is that he had to die for the cause, but the memory of him remains with me ever as a reminder of the real fellowship between all types which made our victory possible.

It was not just one of those things that came to an end with the day's work; it was carried into the evenings by those aircrew and "erks" who were lucky enough to be off for a few hours. There must be many who can recall with a smile the amusing social activities enjoyed by all, not least the squadron dances.

There was never anyone to make much of a song about our work, but as long as the aircrew were satisfied with the results we didn't worry. How many times I have heard the "erks" talking in their billets: "We got three Jerries last week." "We sank two flak ships on Wednesday," or "We shot up six trains last Friday." That was never an attempt to steal the credit, but an expression of the feeling which the "flying types" had brought to them, that they had a share in the job

A u/s aircraft is always a "bind" to an "erk," and in most cases you would find him working feverishly to get things right before anyone started making cutting remarks. If it was a big job then he would not hesitate in letting his colleagues know, and if he was lucky he might solicit a little help. Squadron pride is a great thing, and often the personal pride in a single aircraft exceeds it. Tell an "erk" his "kite" is u/s and he'll just sigh and get out his tools. If you really want to hear him swear just tell him he is on cookhouse fatigue or guard tomorrow!

I say "thank you" to the "flying types" who made us feel they appreciated what was done for them and who allowed us to feel that in a small way we had taken an active part in operations; that is all the tribute we could ever want.

India Command. ONCE AN ERK.

R.A.F. RECRUITING

Air Ministry's "Unimaginative Effort"

IT appears to have been generally accepted that peace for many years to come will only be kept by the threat of force, and the war has shown us how great a part is played by an air force in the wielding of such weapons.

It is also obvious how little the consequent conscription appeals to the public taste, but the Air Ministry's effort to substitute a long-service volunteer force is decidedly unimaginative.

They provide security with pay and paid holidays for a limited period in a man's life with a small cash grant in addition, but during those years, apart from normal discipline, the man must suffer the stultification of natural talent and initiative by the pinpricks of petty restriction.

In the Army, Montgomery is making every effort to throw off the shackles of needless restriction; in the Air Force the perpetual whisper circulates of the "tightening up" to follow, and it certainly does follow, too.

It is considered lowering the dignity of his commission if an officer stoops to explain a regulation to an airman—no, he must be told that "orders are orders," and treated like a child that cannot understand.

We have progressed beyond this stage, and the Army shows its recognition of the fact. The Air Force needs long-service volunteers to master its highly skilled trades, but the Air Ministry remains in a torpor. I have a feeling that this sleeping beauty will not respond to the tender greeting of a gallant prince—it needs a lusty "prang" with a sharp goad!

B. E. J. GARMESON.

THE PISTON ENGINE

". . . Some Years to go in Particular Fields"

I WAS very interested in the article on "The Piston Engine," by C. D. Soltz, in your issue of August 29th.

Mr. Soltz, in his article, states that "too much work has been put into this engine for it to be lightly discarded . . . one of the main advantages of the new jet propulsion turbine airscrew power units, namely their relative ease of development, may allow a certain proportion of our research and development resources to be concentrated on our first pet. . . ."

Perhaps, "lightly" is the operative word in this statement, but even the large amount of development which has been put into the piston engine in the last 25 or 30 years does not justify retaining the piston engine if the gas turbine can replace it adequately. Actually, however, the piston engine still has some years to go in particular fields of use, and the gas turbine, in its power or airscrew form, has yet to prove itself in the range of 500 b.h.p. to 1,500 b.h.p.

At the risk of some of us eating our words, but now at least fortified by further experience, one could say that there is plenty to do in developing the gas turbine and, at the moment, the airscrew turbine is taking just about as long to develop as the piston engine of equivalent power. And any firm engaged in the development of the turbine as well as the piston engine will only have sufficient resources to develop both for specific purposes. No firm will have the

CORRESPONDENCE

capacity to develop the odd piston engine on chance of its being used.

While the gas turbine is completely superior to the piston engine in the very high powers, say above 4,000 b.h.p., I do not agree with Mr. Soltz that development work on the compounding of the piston engine should be discarded; because there are indications that the airscrew/turbine will not be required in powers much in excess of 4,000 shaft horse-power, due to the size of aircraft to be built in the next few years, and the preference for multi-engines from considerations of experience and safety, etc.

Therefore, in the case of the long-range aircraft, the compounded piston engine is very competitive with the airscrew turbine. In fact, if some of our existing piston engines were compounded, one could visualise the airscrew/turbine receiving a serious setback and the jump would then be from the compounded piston engine to the pure jet turbine.

I do not think, however, that such a course will be taken in this country, because the need for the airscrew/turbine is mainly a civil transport one and our piston engines have practically all been developed for military purposes; some firms consider that it might be easier to jump to quite a different prime mover such as the airscrew/turbine in order to recover lost ground and make a very advanced engine for air transportation.

It may well be in America, where the piston engine has been particularly well developed and adapted to the needs of civil air transport, that the case of the compounded piston engine will receive close attention. The Americans have the additional advantage of a well-developed turbo-blower for piston engines.

F. R. BANKS.

FLYING FOR THOUSANDS

Can a Re-born Civil Air Guard be Formed ?

IN this supposedly "advanced" age of a socialist order of things—where equality of opportunity is a shining peak to be won—what is the position of a poor blighter who, wanting desperately to fly, is forced at the same time to earn enough to eat yet who, by the ridiculously low purchasing power of the pound, is utterly unable to afford the present rates of flying? He just can't fly.

Admittedly, it can be argued that private flying—which includes club flying—is a frivolous pastime quite beyond the pale of serious endeavour in putting the world back to some semblance of civilised conditions, but, equally, it can be argued that flying is still only for the prosperous few and, under our present political order, such worldly discrimination is surely anathema. Such being the case, what steps are our enlightened leaders taking to remedy this singularly unequal state of affairs?

I do not for a moment begrudge anyone their present flying. They are just lucky to be able to afford it. All I am bewailing is my own inability to afford it—and, of course, there are thousands in my position.

Would it not be possible for some such scheme as the pre-war Civil Air Guard to be revived? It doesn't much matter what form the scheme takes as long as the thousands of impecunious enthusiasts are given their chance to get into the air.

STEPHEN WATTS.

"Low circuits again."

CLOSE-SUPPORT AIRCRAFT

Specialized Types Advocated

HAVING read your account of the imposing demonstration of Offensive Support at Westdown Ranges, I am prompted to remark on the complete absence of specialized close-support aircraft. Doubtless the Spitfire, Tempest, Meteor and Vampire possess the tractability demanded for this work, but for aircraft of their power they carry an inadequate offensive load. Neither the Spitfire nor the Tempest, both of which are extensively used for dive-bombing, is fitted with dive-brakes, and so far as is known no special armouring for the engine and pilot has been added.

In offensive power these aircraft fall far short of the American XA-41, described in your issue of August 8th, which has a bomb capacity of 6,400lb and is armed with four 37mm and four 0.5in guns.

Perhaps one day we shall see a single-seat close-support machine powered with twin turbine-airscrew units of moderate power (Siddeley Mamba or Rolls-Royce Dart?) with adequate visibility and armour protection, dive brakes, and stowage for, say, 4,000lb of bombs or an equivalent load of rocket projectiles.

"BROWN JOB."

ENCOURAGEMENT FOR FOOLS

With a 40 h.p. 4-cyl. Minimum

THE article "Let us have encouragement for fools" by Risteard MacRoibin in *Flight*, August 22nd, made refreshing reading, and I hope there will be many more on the same topic.

I wonder if we shall ever get back to simple designs. Before the war we tried to adhere to the slogan "Simplify and add more lightness," but that seems to be a forgotten age, and nothing seems satisfactory now unless it is complicated and terribly "modern." To take one example, to connect side-by-side dual control, a torque tube used to be employed, but nowadays it often appears to be necessary for the linkage to include amazing tours all round the cockpit to achieve the same result.

While agreeing, in the main, with the writer's ideas, I am not quite so happy concerning his views on horse-power. I have flown quite a bit with 25 h.p. which was fun, but though the machine (Dart "Kitten") was practically foolproof, I do feel that a greater reserve of power is necessary for take-off. It is disconcerting to require the major length of an airfield to get unstuck, however pleasant it may be once the trees or hangars are behind the aircraft, and, since forced landings are comparatively easy to achieve successfully on these types, I would sacrifice the weight of dual ignition to have a larger engine. Although I visualize, in the distant future, an aircraft which one can more or less "put on," with the present knowledge of design and materials, I think 40 h.p. is the right figure for a single-seater ultra-light plane (which must be robustly built for amateurs); and not less than four cylinders. If some manufacturer could turn engines out cheaply on the lines, for example, of the Continental A-40, and if some future government could be induced to encourage enterprise in the ultra-light sphere, I am sure such movement could progress and much could be learned. It was the engines which killed the movement before the war.

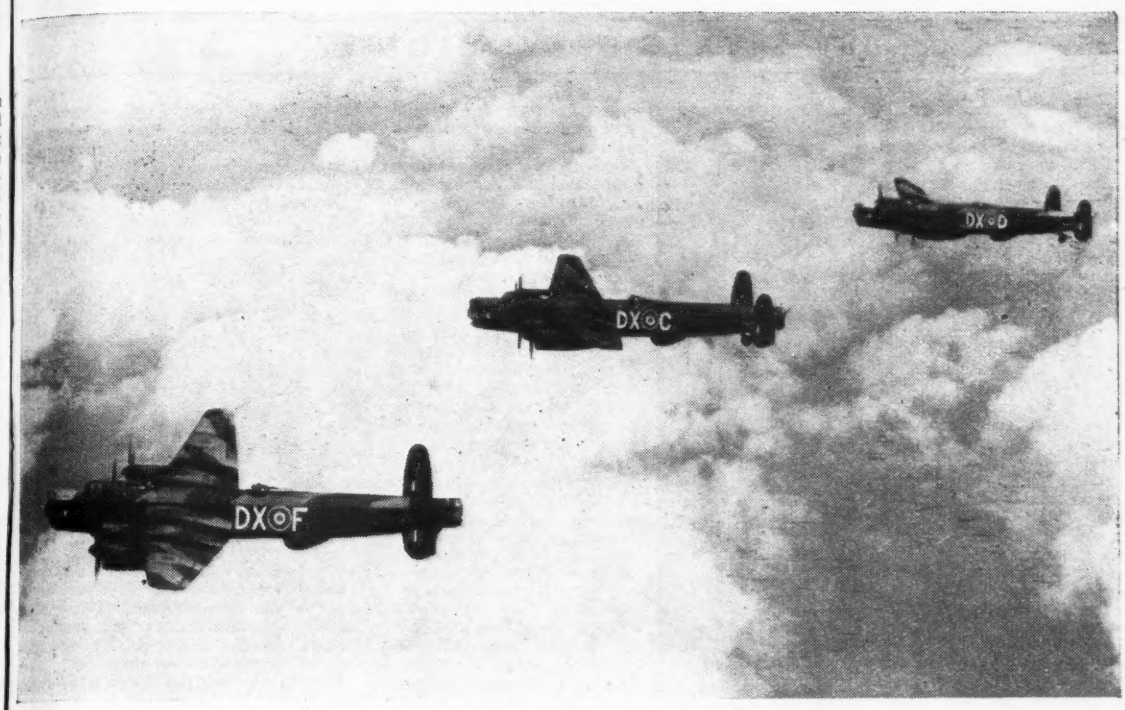
The more one reads of Mignet's work (and I have read everything I can lay my hands on) the more it is apparent that he is or was a genius (by the way, what happened to him during the war?). I admire his work and couldn't agree more with his remarks on single-seaters. I feel that he made mistakes by suggesting that anybody who can make a packing case can make an aircraft, and by not laying sufficient stress on the importance of the C.G., the result being that amateurs installed a variety of engines in the same position in the nose. The C.G. thereupon migrated to dangerous positions, of course, even as it does in the best regulated design offices, the difference being that, in the latter, action is sometimes taken.

It is significant that Henri Mignet, who made no claims to good driving, flew the Pou more than anyone else and had no trouble. His later models—particularly the H.M.18 and that delightful version the Pou Bebe—were never involved in an accident and Mignet took liberties with these creations which would have been impossible with most planes.

A few fatalities killed his movement, yet they were entirely unnecessary.

I hope that Risteard MacRoibin has started something. At any rate, there will be creations at the Paris Exhibition to delight some of our hearts. Wouldn't it have been nice to have been one of the victorious nations?

SQN. LDR. A. H. CURTIS.



NEW EQUIPMENT : Avro Lincoln heavy bombers of No. 57 Squadron present to *Flight's* photographer a picture in which massive power is set against a background of beauty.

SERVICE AVIATION

Royal Air Force and Naval Air Arm News and Announcements

"A Dangerous Position"—C.A.S.

Lord Tedder on Prospects For, and In, the R.A.F. : Some Views on Air Power

R.A.F. fighters, rehearsing for the Battle of Britain Celebration Fly-Past, swept low over the Air Ministry in Whitehall as the Chief of the Air Staff, Marshal of the Royal Air Force The Lord Tedder, spoke of problems confronting the R.A.F., and reiterated some of his views on Air Power. The C. A. S. was characteristically forthright, particularly on the subject of strength; he spoke of the race to fill the R.A.F. with volunteers before the drain-out of our wartime personnel reduced the whole force to impotence. The position, he said was dangerous, and emphasized the word.

In Lord Tedder's view we pulled through the last war because we attained unity in our war effort. "But it took us nearly six years," he said, "and don't let us forget that we had nearly two years' grace—the Munich year and the 'phoney war.' Are we ever likely to be given such grace again? Could we ever again survive such a prolonged strain, such a fantastic expenditure?" he also added.

He knew there were those who said that, with atomic bombs, rockets and all the other refinements which science was now offering, any future war would be so different that any study of the late war would be of purely academic interest. He did not hold that view. The technique of war kept changing with modern conditions, the rate of change got more and more rapid, and it was more and more important to ensure that the technique kept pace with scientific development. But he did not think that principles changed. Neither did he see grounds for complaisance over our conduct of the last war. It was too long and too expensive.

Marshal of the Royal Air Force Lord Tedder, Chief of the Air Staff.

Had the balance of our armed forces, he asked, their equipment and training, their strategy and their tactics kept pace with scientific and technical development? It was over three years, after a series of disasters, before we even began to recover the initiative. Was that solely due to the unpreparedness of a peace-loving democracy? If it was, and if that was the price of democracy, then the future of democracy was indeed perilous. The old tag about the English losing every battle except the last would in a modern world be merely the epitaph of a suicide. Fortunately, it was not true in the last war: we won the Battle of Britain.

Lord Tedder doubted if the potentialities of air power were even yet fully realized, "except possibly by some German leaders—who had the double-edged advantage of being the customers, and were therefore probably right." For the *present* he was sure that recent scientific developments had not superseded but, on the contrary, had enormously enhanced, air power as we know it. This might change, but not yet, and we must live in the present, as well as prepare for future possibilities.

"It is for the Government to decide,"

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said Lord Tedder, "what proportion of the national resources are to be allocated to the various component parts of the national defence, uniformed and civilian. It is clear on the one hand that such allocation should be such as to ensure security against a far more sudden and far heavier attack than we suffered last time; on the other hand it is equally clear that we must find every possible means of economizing in our defence expenditure—if we expend too much on defence we shall have nothing left worth defending." When he said "economy," he did not mean "doing things on the cheap," he referred to the real economy one gets from efficiency and a proper balancing of forces.

C.A.S. believed that the keywords for the future were flexibility and speed and felt that the days of the leviathan were over, so far as warfare was concerned. "I think the future lies with David and not Goliath," he said.

New Aircrew badges. (Top) Master Aircrew, (Centre) Aircrew I, (Bottom) Aircrew II.

Regarding the ultimate size of the R.A.F., Lord Tedder could say little. The strength of the Air Force was bound up with the strength of the armed forces as a whole and the Government could make no immediate decision on the ultimate allocation of resources to any one service until they had thoroughly evaluated the effect of recent developments in the technique of modern warfare.

"As to the shape of the Air Force," C. A. S. continued, "we aim to maintain a balanced peace-time force capable on the one hand of meeting its many peacetime commitments, and on the other hand, in the event of war, of meeting the initial shock and of expanding to exert the full and decisive force of air power. In the old days, and even as late as 1940, there were people who said that all we needed for the defence of this country was fighters. I think the history of the *Luftwaffe* exposes that fallacy."

In our peacetime force, maintained Lord Tedder, we must strike the right balance between defence and offence, between short-range tactical support for the land and sea forces and long-range forces capable of operating strategically or tactically as the situation demanded. We must also maintain an air transport force to ensure a certain degree of mobility not only to our air forces but also to the land forces.

We were doing our best to attain economy, said Lord Tedder, not only the economy attained by cutting out non-essentials (on this account many desirable things had been cut) but also the economy to be gained by improving efficiency. For many months teams of scientific investigators had been examining various aspects of Service administration, to see where man-power could be saved, whether by altering administrative methods, improving or rearranging equipment, diluting skilled labour with more unskilled, or in other ways. Cookhouses, unit orderly rooms, accounting systems and officers' messes were some of the items examined which had "given a line" on valuable economies.

"It is indeed fortunate," said C. A. S., "that we have already made some headway in this, for frankly, we are more and more up against it. We are more and more faced by the vital and urgent need to re-establish the permanent element of the Force. During the war the R.A.F. was not permitted to continue regular recruitment. The only long-term-engagement airmen in the Service at the end of the war were those who had been serving at the outbreak. Their numbers are small and are dwindling further rapidly. The vast majority of the Service are those who are on war-emergency engagement, and those are fast being demobilized. It is thus a race with time. A race to fill up the Force with volunteers before the drain-out of our wartime personnel reduces the whole Force to impotence. I must speak frankly. The position is dangerous—I mean *dangerous*."

A largely technical Force like the R.A.F., which in one sense is always on active service, must have skilled men both on the ground and in the air. To get the skill and experience demanded volunteers were required who hoped to stay in the Service. A National Service element was essential to serve as a basis for expansion in the event of war, but in peace-time the National Service entrant would not be long enough in the R.A.F. to give much productive service or to complete the normal overseas tour. "Further," said Lord Tedder, "he won't have sufficient training, much less experience, to become a useful member of an aircrew or of the maintenance crew of a modern aircraft."

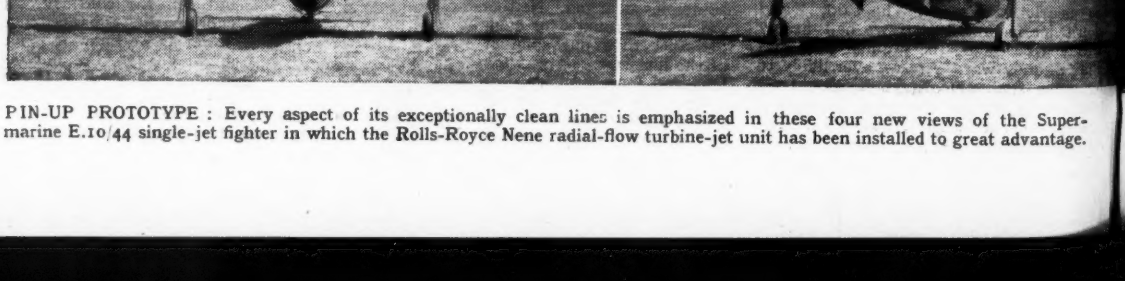
No "Bribes"

A recruiting campaign had begun and a bounty scheme introduced to encourage men to join or re-engage. But again, Lord Tedder said bluntly, that results so far are gravely disappointing and we were in danger of losing the race.

Lord Tedder had heard talk of a "New Deal" for the Air Force which would help recuiting. Personally he was not a believer in bribes; he did not think that "a policy of bread and circuses" was likely to be any healthier for the Royal Air Force than it was for the Roman Empire. He knew of no New Deal, but did believe in a Square Deal.

New Aircrew badges. (Top) Aircrew III. (Centre) Aircrew IV. (Bottom) Aircrew Cadet

For many months active plans had been going ahead for replacing some of the scattered and primitive wartime stations with proper and decent peacetime accommodation, accommodation which would bear comparison with that which a man could reasonably expect in civilian life. These plans had been widely circulated and discussed with all ranks, and specimens erected at Newmarket. Moreover, the R.A.F. was also going ahead as fast as money and the civilian housing programme would allow towards meeting one of the most urgent needs—that of married quarters.



PIN-UP PROTOTYPE : Every aspect of its exceptionally clean lines is emphasized in these four new views of the Supermarine E.10/44 single-jet fighter in which the Rolls-Royce Nene radial-flow turbine-jet unit has been installed to great advantage.

The Battle of Britain

Excerpts from an Historic Despatch by Air Chief Marshal Sir Hugh Dowding

IN the Supplement to the *London Gazette* published on Tuesday, September 10th, 1946 (H.M. Stationery Office, price 2s), is printed a despatch submitted to the Secretary of State for Air on August 20th, 1941, by Air Chief Marshal Sir Hugh C. T. Dowding, G.C.B., G.C.V.O., C.M.G., A.D.C., Air Officer Commanding-in-Chief, Fighter Command, Royal Air Force. Below are given brief extracts from this extremely comprehensive review of the state and organization of our Fighter Squadrons and defences before, during, and after the Battle. Sir Chief Marshal Sir Hugh Dowding also refers in some detail to the part played by guns, searchlights, the Royal Observer Corps, radiolocation systems and air-raid warning systems, etc. Night operations and night fighter interception methods are discussed, also methods of employing the various ground defences. Offensive and defensive equipment of aircraft, and statistics, are given in appendices.

Sir Hugh writes: "In giving an account of the Battle of Britain it is perhaps advisable to begin by a definition of my conception of the meaning of the phrase. The Battle may be said to have started when the Germans had disposed of the French resistance in the summer of 1940, and turned their attention to this country. The essence of their strategy was so to weaken our fighter defences that their air arm would be able to give adequate support to an attempted invasion of the British Isles.

"This air supremacy was doubly necessary to them in attacking England because the bulk of their troops and war material must necessarily be conveyed by sea.

"Their immediate objectives might be convoys, radiolocation stations, fighter aerodromes, seaports, aircraft factories, or London itself. Always the underlying object was to bring the Fighter Command continuously to battle, and to weaken its material resources and intelligence facilities.

"Long after the policy of 'crashing through' with heavy bomber formations had been abandoned owing to the shattering losses incurred, the Battle went on. Large fighter formations were sent over, a proportion of the fighters being adapted to carry bombs, in order that the attacks might not be ignored. The 'Battle of Britain' may be said to have ended when the fighter and fighter-bomber raids died down.

> *"If the fighter defence had failed in the autumn of 1940 England would have been invaded."*
>
> *"Heavy pressure was kept up till the 27th September, but by the end of the month it became apparent that the Germans could no longer face the bomber wastage which they had sustained . . . . ."*

"The moral and material disadvantages of fighting over enemy country may well have determined the Germans to open the attack with a phase of fighting in which the advantages were more evenly balanced. I have therefore, somewhat arbitrarily, chosen the events of July 10th as the opening of the Battle. Although many attacks had previously been made on convoys, and even on land objectives such as Portland, July 10th saw the employment by the Germans of the first really big formation (70 aircraft), intended primarily to bring our fighter defence to battle on a large scale.

Air Chief Marshal Lord Dowding.

"I had 59 squadrons in various stages of efficiency. (A list of these units is given in Appendix A of the Supplement.) Many of them were still suffering from the effects of the fighting in Holland and Flanders, at Dunkerque, and during the subsequent operations in France. Others were in process of formation and training. . . . If the lessons of the Battle are to be correctly appreciated, due consideration must be given to the factors leading up to the situation existing when it began.

"The first major problem arose during the discussion of the question of sending fighter squadrons to France. The decisive factor was that of supply. Our output at the beginning of the war was about two Hurricanes and two Spitfires per diem; and, although there were hopes of increasing Hurricane production, there was then no hope that Spitfire production would be materially increased for about a year.

"I wanted 12 new squadrons, but asked that eight should be raised immediately, and made proposals for their location and employment."

Sir Hugh then described how, after correspondence between himself and the Air Ministry, it was agreed in October, 1939, to form ten additional fighter squadrons, four of which were for Coastal Command.

Of radiolocation the C.-in-C. says:—

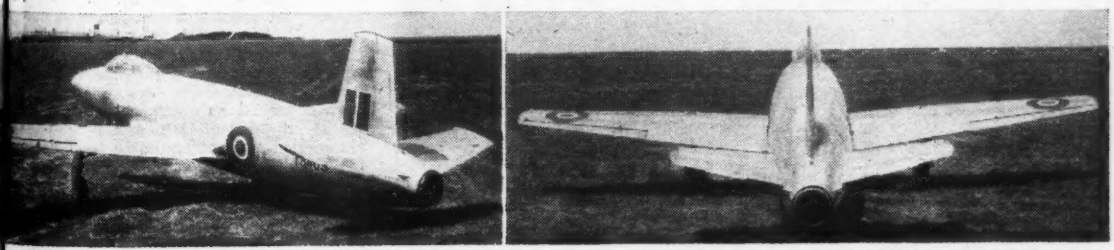
"The radiolocation system was growing so fast and had to meet so many calls from overseas that the training of the technical personnel and the maintenance of the elaborate scientific apparatus presented great difficulties. In spite of these handicaps, however, the system operated effectively, and it is not too much to say that the warnings which it gave could have been obtained by no other means and constituted a vital factor in the Air Defence of Great Britain."

After reviewing the characteristics of the various types of Allied and enemy aircraft then being used, the C.-in-C. refers briefly to the two publications, *The Battle of Britain*, and *Fighter Command*, and says that, in the latter, the speed of the Hurricane was "seriously overrated at 335 m.p.h." He carried out a series of trials and it averaged about 305 m.p.h.

Sir Hugh also criticized the statement contained in *Fighter Command* to the effect that the R.A.F. fighter squadrons were "stronger at the end of the Battle than at the beginning."

"Whatever the study of paper returns may have shown, the fact is that the situation was critical in the extreme.

"The decisive features of the Battle



Such outstanding aircraft will be demanded for the efficient but economical Air Force desired by Lord Tedder. Fortunately the British aircraft industry has always been able to build the world's finest military aircraft.

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were the ratio of casualties incurred by ourselves and the Germans, and the ratio of casualties to the numbers actively employed on both sides. (Appendix D of the supplement has been drawn up with these points in mind.)

"If we allow for a percentage of overstatement, and the fact that two or more fighters were sometimes firing at the same enemy aircraft without being aware of the fact, this can fairly be balanced by the certainty that a proportion of aircraft reported as 'Probably Destroyed' or 'Damaged' failed to return to their bases. The figures, then, are put forward as an honest approximation. Judging by results, they are perhaps not far out.

"It has been estimated that the Germans sent over, on an average throughout the Battle, four fighters to each bomber or fighter-bomber, but any such estimate must be very rough.

"I must emphasize, throughout, the extreme versatility of the German methods both in the timing and direction of their attacks, and in the tactical formations and methods employed. They enjoyed the great advantage of having a wide front from which attacks could be delivered. First a blow would be delivered from Calais, perhaps against London; then after a carefully-timed interval, when 11 Group fighters might be expected to be at the end of their petrol endurance, a heavy attack would be made on Southampton and Portland. Other attacks, after being built up to formidable dimensions, would prove to be only feints, and the bombers would turn away before reaching the coast of England, only to return again in half an hour, when the fighters, sent up to intercept them, were landing."

Dealing with damage, the C.-in-C. states:—"Three of the radiolocation stations in the South of England suffered rather severe damage and casualties. No station was permanently put out of action, and the worst damage was repaired in about a month.

"As regards aerodromes, Manston was the worst sufferer at this stage. It, Hawkinge and Lympne were the three advanced grounds on which we relied for filling up tanks when a maximum range was required for operations over France. They were so heavily attacked with bombs and machine guns that they were temporarily abandoned.

"Only non-essential personnel took cover; aircraft crews and the staff of the Operations Room remained at their posts. At Kenley and at Biggin Hill direct hits were sustained on trenches.

"It was also about this time that the final decision was made to relegate the Defiant to night operations. It had two serious disabilities; first, the brain flying the aircraft was not the brain firing the guns: the guns could not fire within 16 degrees of the line of flight of the aircraft and the gunner was distracted from his task by having to direct the pilot through the communication set. Secondly, the guns could not be fired below the horizontal, and it was therefore necessary to keep below the enemy.

Air/Sea Rescue

"Throughout the Battle, of course, fighting continually occurred over the sea, and German aircraft, damaged over England, had to return across the Straits of Dover or the English Channel. Far more German than British crews fell into the sea. The Germans therefore developed an elaborate system of sea-rescue. Floating refuges with provisions and wireless sets were anchored off the French coast. 'E' Boats and rescue launches were extensively employed, and white-painted float-planes, marked with the Red Cross, were used even in the midst of battle. We had to make it known to the Germans that we could not countenance the use of the Red Cross in this manner.

"About this time one Canadian, two Polish and one Czech squadrons became fit for operations. A squadron of Canadian pilots of the Royal Air Force (No. 242) had been in existence for some months. No. 1 (Canadian) Squadron, now also came into line and acquitted itself with great distinction. The American "Eagle" Squadron was in process of formation during the Battle.

"The Auxiliary Squadrons were by this time practically indistinguishable from Regulars.

"The first-line strength of a squadron was 16 aircraft, of which not more than 12 were intended to be operationally available at any one time. In addition to this there was a small reserve of three to five aircraft per squadron.

"A fresh squadron coming into an active sector would generally bring with them 16 aircraft and about 20 trained pilots. They would normally fight until they were no longer capable of putting more than nine aircraft into the air, and then they had to be relieved. The normal period was a month to six weeks, but some units had to be replaced after a week or 10 days.

"By the beginning of September the incidence of casualties became so serious that a fresh squadron would become depleted and exhausted before any of the resting and reforming squadrons was ready to take its place. At the end of the second phase of the Battle, the power of reinforcing by complete units had substantially disappeared. If the fighter defence had failed in the autumn of 1940, England would have been invaded.

"The confidence of the German High Command probably received something of a shock about this time. The sustained resistance which they were meeting in south-east England probably led them to believe that fighter squadrons had been withdrawn, wholly or in part, from the north in order to meet the attack. On August 15th, therefore, two large raids were sent, one to Yorkshire and one to Newcastle. They were escorted by fighters.

"If the assumption was that our fighters had been withdrawn from the north, the contrary was soon apparent, and the bombers received such a drubbing that the experiment was not repeated. This incident probably had a very depressing influence on the outlook of the German High Command.

"The most critical stage of the Battle occurred in the third phase. On September 15th the Germans delivered their maximum effort, when our guns and fighters together accounted for 185 aircraft. Heavy pressure was kept up till September 27th, but, by the end of the month, it became apparent that the Germans could no longer face the bomber wastage which they had sustained, and the operations entered upon their fourth phase, in which a proportion of enemy fighters themselves acted as bombers.

Spitfire Recce

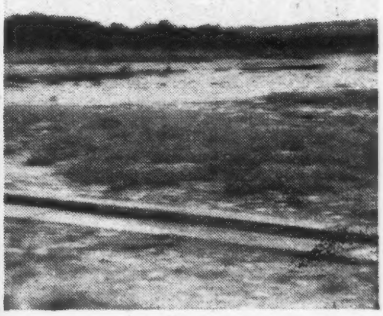
"Apart from the previous difficulty of determining which formations meant business, and which were feints, we had to discover which formations carried bombs and which did not. To meet this difficulty, Air Vice-Marshal Park devised the plan of using single Spitfires (later pairs) flying at maximum height, to act as reconnaissance aircraft and to report their observations immediately by R/T.

"By the end of October the Germans abandoned their attempts to wear down the Fighter Command, and the country was delivered from the threat of invasion.

"The experience of the Battle made me a little doubtful if the organization of a squadron into two flights, each of two sections of three aircraft, was ideal. The weakness lay in the section of three when it became necessary to break up

W.A.A.F. WINNERS: The W.A.A.F. Cricket Team, R.A.F. Station, Wittering, which won the Inter-Station W.A.A.F. Cricket Tournament. L. to R., standing: F/O. Blount (Coach); A/CW. Armstrong; L.A/CW. Pickering, Group Capt. Hammond (Commanding Officer); A/CW. Skeet; L.A/CW. Taylor; Sgt. Dunn (P.T.I.); Flt. Lt. Taylor (Sports Officer). Sitting: L.A/CW. Wilcox; A/CW. Kembery; S/O. Ogilvie; Cpl. Greenwood (Capt.); Cpl. Parkin; A/CW. Conroy; L.A/CW. Teague.

BOMBER LIAISON : A Lincoln of the Central Bomber Establishment, Marham, is on a five-week liaison flight to the Far East, Australia and New Zealand. Above is the aircraft, named *Excalibur*, and below are members of the crew. Third from left is Group Capt. S. C. Elworthy, C.B.E., D.S.O., D.F.C., A.F.C. ; to the left are Wing Cdr. D. C. MacKinley, D.F.C., A.F.C., and Wing Cdr. R. H. Wingfield, D.F.C., A.F.C., and on the right Wing Cdr. R. C. Ayling.



into pairs, in which one pilot looks after the tail of his companion.

"The types of ammunition used in the guns varied during the course of the Battle. It was necessary to include some incendiary ammunition, but the type originally available gave a distinct smoke-tracer effect. Now tracer ammunition in fixed guns at any but very short range gives very misleading indications, and I wished pilots to use their sights properly and not to rely on tracer indications. (The above remarks do not apply at night, nor to free guns, where tracer is essential for one of the methods taught for aiming).

"During the Battle 'de Wilde' ammunition became available in increasing quantities. This was an incendiary ammunition without any flame or smoke trace, and it was extremely popular with pilots. Eight-gun fighters, of course, were always liable to be sent up at night, and it was therefore desirable to retain some of the older types of incendiary bullets. These were preferred to the 'tracer' proper, which gave too bright a flame at night.

"A typical arrangement, therefore, was: old-type incendiary in the two outer guns, 'de Wilde' in one gun (while supplies were limited), armour piercing in two guns, and ball in the other three."

68 Squadron Dinner

NO. 68 Squadron Dinner will be held on October 19th at the Dorchester Hotel, London. Those wishing to attend should communicate with Mr. L. W. Kohler, 16a, Marlborough Road, Richmond, Surrey.

R.A.A.F. Equipment

FUTURE equipment of the Royal Australian Air Force will include squadrons of Avro Lincoln heavy bombers and De Havilland Vampire jet fighters. Tudor transport aircraft will also be adopted.

Siamese Rescue R.A.F. Crew

THE R.A.F. crew of a reconnaissance Mosquito, which was forced down on an uninhabited island in the Gulf of Siam, have been rescued and brought back to the mainland by the Siamese Air Force. The Mosquito, belonging to No. 684 (Photographic Reconnaissance) Squadron, was on a ferry flight from Rangoon to Seletar, Singapore, via Bangkok, and was reported missing on August 23.

A search was immediately initiated and the missing aircraft spotted by the pilot of another Mosquito. It had force-landed on an island between Ko Chang and Ko Ma, some 160 miles south-east of Bangkok, in the Gulf of Siam, and the crew of two were uninjured. A Siamese floatplane landed off the island on August 27, and the R.A.F. crew were picked up and flown safely across to Satah Heep, where transport awaited them for Bangkok.

Appointment

THE Air Ministry announces the following Royal Air Force appointment:—

Air Vice-Marshal Gerald Ernest Gibbs, C.I.E., C.B.E., M.C., to Headquarters, Transport Command, as Senior Air Staff Officer.

Air Vice-Marshal Gibbs has been Deputy Chief of Staff (Air) at Supreme Allied Headquarters, South East Asia, since April, 1945, and was formerly, for a short time, Air Officer Commanding a group in Air Command, South East Asia From December, 1944, until early in last year he was Senior Air Staff Officer at R.A.F. Headquarters, Bengal, and he previously held a similar appointment at Headquarters, of the 3rd T.A.F., A.C.S.E.A. He was Senior Air Staff Officer at No. 11 Group during the Battle of Britain, occupying the post from June, 1940, to the beginning of 1942.

Bomber Liaison

THE R.A.F. Central Bomber Establishment's first overseas liaison mission began on Monday, September 9, when a Lincoln left Blackbushe for a five-week tour of the Far East, Australia and New Zealand. This will be the first visit of a Lincoln to Australia and New Zealand. The Mission will discuss bomber tactics with certain R.A.F. Overseas Commands and with the R.A.A.F. and the R.N.Z.A.F., and investigate their own individual bomber problems.

Although the Empire Air Armament and Navigation Schools have performed similar liaison missions, this is the first occasion in which the Bomber equivalent of these Empire Schools has done so. The Mission will also give lectures if required, and hold conferences on present bombing policy and on possible developments. During the course of the flight the crew will be able to make a practical examination of the problems connected with long-range reinforcement flights by standard bomber aircraft.

The Lincoln was to fly by way of Lydda, Mauripur (India), Changi (Singapore) and Darwin, and to arrive on September 15th at Laverton, Melbourne, where it will stay five days before moving on to Richmond, Sydney, on September 18th. After five days at Sydney the Mission will fly on September 23rd to Chakia, Wellington, which it will leave on September 27th, for Whenuapai, Auckland.

Leaving Whenuapai on October 1st, it will fly via Townsville, Queensland, and Darwin for Changi, Singapore, arriving on October 3rd. After a five-day stay at Singapore it will travel to Negombe, Colombo, where a two-day halt from October 8th to 10th will be made, before passing on to Palam, Delhi. At Delhi there will be a four-day visit from October 10th-14th, after which the Mission will return via Lydda to Manston, arriving on October 15th.

The captain of the aircraft and officer in charge of the Mission is Group Captain Elworthy, a New Zealander who is head of the Tactical Wing of the Central Bomber Establishment at Marham. His deputy captain and first navigator is Wing Commander D. C. MacKinley.

SERVICE AVIATION

D.F.C., A.F.C., who captained the *Aries* on its North Pole flights.

The Central Bomber Establishment, set up at Marham, Norfolk, in October last under Air Commodore G. R. C. Spencer, C.B.E., to be the R.A.F.'s Empire centre for the study and operational development of bomber tactics and equipment, consists at present of two Wings, the Tactics Wing and the Development Wing. The Tactics Wing, under Group Captain S. C. Elworthy, exists chiefly to study the tactical doctrine of bomber aircraft and maintain effective liaison on questions relating to bombers and their equipment with the R.A.F. throughout the world, with certain civilian establishments and with Dominions Air Forces, by such means as this Mission.

The Development Wing, under Group Captain J. H. T. Simpson, D.S.O., is the principal flying unit and is responsible for the operational testing and development of bomber aircraft armament and equipment.

Permanent Commissions in the R.A.F.

IN future, R.A.F. officers who do not reply to the offer of an Extended Service or Permanent Commission strictly within the time limits laid down will be considered to have refused the offer.

Those who have been offered permanent commissions up to and including August 8 and have not already notified their acceptance or refusal, should signal Air Ministry (A.R.7) by September 30 or the offers will be cancelled. Similarly, those who were offered extended service commissions up to and including July 6 and have not yet notified their decisions, must do so by September 30, or these offers also will be cancelled.

The time limits now allowed are: three weeks and eight weeks from the date of making the offer for R.A.F. Home and Overseas Commands respectively. The only exceptions to the time limit will be where it is impossible for an officer to be medically examined within the time laid down.

Towards the end of May the offer of 2,000 Permanent and 8,000 Extended Service Commissions was announced. The selection of officers for these commissions is going well, but it has become clear that the time limits must be enforced.

The badge of No. 5 Glider Training School R.A.F.—"Per Diligentiam Vincimus" — By Diligence We Conquer.

Roll of Honour

Casualty Communiqué No. 602

THE Air Ministry regret to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list 191 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. R. D. Cameron.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. T. Aisbitt; Flt. Sgt. P. Anson; Sgt. L. G. Clarke; Act. Wing Cdr. W. D. L. Filson-Young, D.F.C.; Flt. Sgt. H. N. Harrison; F/O. R. F. Harrison; Sgt. P. W. Higdon; Act. Sqn. Ldr. M. W. Hubble; Sgt. H. Law; Sgt. P. A. Neale; Flt. Lt. E. W. Newman; Flt. Sgt. C. F. Nicholz; Flt. Sgt. C. Nunn; F/O. H. L. O'Neill; Flt. Sgt. R. Page; F/O. N. E. Passey; Flt. Lt. P. Rathie; Sgt. J. J. R. Raybould; F/O. T. D. M. Ross; Flt. Sgt. N. H. W. Stuart; Flt. Lt. R. G. V. Waters; Flt. Sgt. R. C. Winchester.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. E. A. Allen; F/O. R. W. Anderson; Flt. Lt. N. L. Baugh; Flt. Lt. J. W. Bennett; F/O. W. E. Besso; Sgt. F. Bloss; Flt. Sgt. A. J. Bonner; Sgt. D. R. A. Burgess; Flt. Sgt. A. R. Burn; W/O. K. S. Callicott; Sgt. T. Carr; P/O. B. Clifton, D.F.M.; Flt. Lt. R. M. Coles; Sgt. A. E. Collingwood; Flt. Lt. D. Cookson; Flt. Sgt. D. N. Crawford; Sgt. D. Crawford; Flt. Lt. E. S. C. Cross; Act. Sqn. Ldr. R. N. Dagnall; Sgt. A. T. E. Daniells; F/O. E. Davies; Flt. Sgt. H. Deeny; Sgt. W. C. F. Dodd; W/O. Durrant; P/O. S. J. Elias; Flt. Sgt. G. Firth, D.F.M.; Flt. Lt. A. B. Gilbert; Act. Flt. Lt. J. R. Graham; W/O. J. Hartley; F/O. D. J. Herbert; W/O. K. Illingworth; Flt. Sgt. F. J. M. Ireland; W/O. R. F. Juffs; Sgt. R. M. Kemp; Flt. Lt. H. D. T. Leach; Sgt. J. H. S. Leak; L.A/C. I. Lewis; W/O. G. H. Lloyd; Flt. Sgt. S. Lock; Flt. Sgt. J. L. Longhurst; Flt. Sgt. J. M. McKay; F/O. N. S. Morton; Flt. Sgt. T. P. Nathaniel; Sgt. F. E. Naylor; Sgt. J. O. Nicholls; Flt. Sgt. K. T. Orton; Sgt. A. J. N. Owen; F/O. R. S. Painter; F/O. T. R. Pallet; Sgt. G. A. C. Plank; W/O. S. J. Plater; Flt. Sgt. D. R. Quaintance; Act. Sqn. Ldr. J. Rhind; Sgt. S. J. Riding; Flt. Sgt. A. Robertson; F/O. R. G. Savory; Flt. Sgt. F. Somerville; F/O. R. H. Stenning; Sgt. A. E. B. Stout; Sgt. J. Sutcliffe; Flt. Sgt. G. E. Thick; Sgt. D. W. Underwood; Act. Sgt. R. D. Walker; P/O. R. F. Walliker; Sgt. J. K. Welburn; F/O. F. F. White; W/O. V. E. Whitehall; Flt. Sgt. E. R. J. Williams; Flt. Sgt. J. C. W. Williamson; A/C.1 T. G. Williamson; Flt. Lt. T. Woodhouse; Flt. Sgt. E. W. Wright.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED KILLED IN ACTION.—F/O. E. L. Carmichael; F/O. J. L. Halcrow.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Flt. Lt. R. F. Escreet.

MISSING.—F/O. H. A. Beer; F/O. L. B. Bradley; W/O. E. C. Cook; F/O. W. K. Cooper; Flt. Lt. W. Gorley; F/O. G. F. Humes; W/O. D. Main; Flt. Sgt. J. Raby; W/O. D. C. Redfern; Flt. Sgt. J. E. L. Rhodes; Flt. Sgt. F. Robinson; Flt. Lt. F. B. Shaw; F/O. B. G. Stedman; W/O. L. E. Welch.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—A/C.2 A. H. Derges; L.A/C. H. Postons; W/O. E. S. C. Small.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. B. C. Acton; Sgt. A. F. B. Blaikley; F/O. K. D. Bodden; Sgt. A. Bone; F/O. A. F. Chesterfield; P/O. E. H. Coe; F/O. J. H. Craig; Flt. Lt. R. Cumming; W/O. C. S. Cunningham; Flt. Lt. K. C. D. Dart; Flt. Sgt. F. K. Dexter; F/O. M. R. Earley; Flt. Sgt. L. W. J. Evans; Flt. Lt. S. R. Gent; Act. Flt. Lt. J. Hall; F/O. W. T. Hardie; Flt. Lt. J. M. Hayton; Sgt. J. Hewitt; W/O. R. N. L. Holmes; Sgt. F. C. Horn; Flt. Sgt. E. A. Imrie; L.A/C. A. G. Jell; Flt. Lt. O. H. E. Jones; Flt. Sgt. D. S. H. Logan; F/O. H. G. McClure; L.A/C. A. C. Milne; W/O. R. T. Nutting; Sgt. A. Paramanathan; Flt. Sgt. C. A. Payne; L.A/C. W. J. C. Payne; Flt. Lt. E. W. Ratcliffe; F/O. R. H. Regan; Flt. Sgt. A. J. Rossiter; Flt. Sgt. W. J. Strachan; Flt. Sgt. A. A. W. Thomas; Sgt. T. E. Valler; Flt. Lt. G. C. G. Warburton; F/O. J. S. Wood.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—A/C.1 A. Bonnett.

MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. D. T. Brown; F/O. R. G. Cummings; W/O. E. S. Newark; F/O G. B. Sharp; Act. Cpl. A. H. F. Sparkes; P/O. B. F. Stacey; A/C.1 R. G. Stephens; Flt. Sgt. J. K. Thrower; A/C.1 C. D. Tyrrell; L.A/C. E. R. Underwood; A/C.1 R. N. Vaux.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—F/O. K. W. Bennett; W/O. G. G. Jessup; F/O. H. J. Platts.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. D. Anderson; Flt. Sgt. C. E. F. Blake; Sgt. G. A. Boddy; W/O. R. Broughton; F/O. C. R. A. Browning; F/O. J. C. Burns, D.F.M.; Sgt. P. Cumberworth; F/O. L. S. Drew, D.F.C.; Flt. Sgt. R. Eglen; W/O. G. H. Fenney; F/O. A. G. Flippance; Flt. Sgt. L. P. Green; F/O. F. D. Irvine; Sgt. W. J. Kennedy; Flt. Sgt. E. E. W. King; Sgt. A. L. Knight; P/O. J. O. Laverack; F/O. W. S. Lees; Sgt. D. C. MacLean; Act. Sqn. Ldr. R. W. S. Marshall; Sgt. R. T. Martin; Sgt. S. H. Mortimer; Sgt. J. O. E. Ogden; P/O. E. T. Owen; F/O. K. Parmenter, D.F.M.; W/O. K. W. Robinson; P/O. J. C. Prince; Flt. Sgt. J. A. Reardon; Flt. Sgt. N. R. Robbins; Sgt. E. C. M. Selley; F/O. N. F. Sidwell, D.F.C.; F/O. J. R. Skinner; F/O. E. A. Smith; Sgt. R. G. Steel; Act. Flt Lt. G. Taylor; Flt. Sgt. J. Thursfield; W/O. J. E. Topple; Sgt. R. J. Trebble; Flt. Lt. N. C. Trigg; Flt. Sgt. R. V. Vickers; W/O. W. H. C. Ward; W/O. P. Webb; Flt. Lt. J. P. Whymark, D.S.O., D.F.C.; Flt. Sgt. F. B. Wilkinson; W/O. A. T. Worthington; Flt. Lt. H. Wroe.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. F. Bretton; Flt. Sgt. C. A. Ellis; Flt. Sgt. E. Holloway; L.A/C. J. B. McNair; Flt. Sgt. F. G. Russell; Flt. Sgt. J. Watson.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Flt. Lt. G. E. Brooks; Sgt. W. S. Stoddart.

The badge of No. 32 Maintenance Unit R.A.F.—"I will make Good."

DIED ON ACTIVE SERVICE.—Act. Sqn. Ldr. S. K. Barnes; L.A/C. W. J. Blaney; L.A/C. J. Carter; L.A/C. C. Cole; L.A/C. T. Connor; L.A/C. R. Cope; Flt. Lt. J. D. Craig; L.A/C. F. Crosbie; L.A/C. D. R. F. Davidson; Sgt. K. C. H. Dean; W/O. S. G. Dyer; L.A/C. P. C. Edwards; L.A/C. W. Emery; L.A/C. R. W. Entwistle; Flt. Lt. L. Falgate, D.F.C.; F/O. L. I. Friedlander; A/C. J. W. Harbottle; W/O. K. S. Harvey; L.A/C. E. J. Heath; Sgt. R. B. Hill; L.A/C. J. D. Hobson; L.A/C. E. Ingham; L.A/C. N. E. Johns; Cpl. W. K. Johnston; L.A/C. H. Kighley; L.A/C. J. D. H. Knowles; L.A/C. C. E. Lewis; L.A/C. R. Lonsdale; L.A/C. F. J. Lovett; Act. Sqn. Ldr. S. G. G. Luhman; L.A/C. J. McConnell; Act. Sgt. C. J. McEvoy; A/C.2 J. McKenzie; L.A/C. J. McKerrell; Sgt. R. Mackinder; L.A/C. T. Manser; A/C.2 J. W. Marshall; F/O. J. Massey; Cpl. D. A. G. Matthews; A/C.2 W. Millican; Cpl. W. Mirrlees; A/C.1 R. Myers; F/O. T. G. Newman; Cpl. J. H. North; A/C.2 G. A. Odling; W/O. W. E. Parkhurst; L.A/C. W. Parkin; Flt. Sgt. C. Patterson; Cpl. R. E. Penny; Flt. Sgt. S. G. Phillips; L.A/C. H. Phillipson; A/C.1 T. Pickles; L.A/C. R. G. Pratley; Cpl. G. W. Rayworth; F/O. M. J. Reilly; Flt. Lt. D. E. Ross; Cpl. J. J. Ryan; L.A/C. W. Shepherd; Flt. Lt. A. M. Smith; L.A/C. D. E. Smith; A/C.2 M. C. Stapleton; Flt. Lt. J. Stephenson; Cpl. S. V. E. Swatton; L.A/C. L. D. Thomas; L.A/C. L. Titman; Cpl. L. W. Trentfield; L.A/C. L. S. Wardell; Act. Cpl. R. Warner; L.A/C. D. M. Williams.

PREVIOUSLY REPORTED MISSING, NOW REPORTED DIED ON ACTIVE SERVICE.—Flt. Lt. D. J. Dawson.

Women's Auxiliary Air Force

KILLED ON ACTIVE SERVICE.—Sgt. E. M. Eaton; L.A/CW. P. M. Savage.

DIED ON ACTIVE SERVICE.—Cpl. M. W. Ayers; L.A/CW. O. R. Coles; L.A/CW. U. A. Evans; L.A/CW. V. E. D. Harris; L.A/CW. P. F. E. Holmes.

Royal Australian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—W/O. M. B. Crockett; W/O. A. H. M. Davidson; P/O. R. S. Jack; Flt. Sgt. F. J. O'Neill; W/O. J. K. S. Radnidge; P/O. J. C. Saisell; Flt. Sgt. W. J. Thompson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. A. E. Arnold; F/O. F. H. Baggs; W/O. J. Begg; W/O. N. O. Bowden; Flt. Sgt. L. Cain; F/O. H. J. M. Campbell; Flt. Lt. S. L. Cary; P/O. J. Cohen; Flt. Sgt. M. H. Crossing; P/O. E. A. Faber; F/O. K. Fuller; Flt. Sgt. M. J. Gordon; P/O. P. M. Gunn; Sgt. P. C. Hay; Act. Sqn. Ldr. K. V. Ingham, D.F.C.; W/O. G. E. Ising; P/O. T. K. F. X. Leavey; Flt. Lt. T. S. McCartney; Flt. Sgt. R. W. McCulloch; W/O. A. G. Nourse; Flt. Sgt. R. G. Petch; W/O. K. R. Phelps; P/O. R. N. Pittendrigh; Flt. Sgt. R. G. Pryor; W/O. D. R. Rayner; W/O. J. W. D. Reid; Flt. Sgt. A. W. Robinson; Flt. Sgt. B. J. Stanford; Flt. Lt. J. P. D. Thomson; Flt. Sgt. M. R. Vagg; P/O. C. A. Walton; Flt. Sgt. E. F. Warmer.

DIED ON ACTIVE SERVICE.—Flt. Lt. Deland.

Royal Canadian Air Force

DIED ON ACTIVE SERVICE—W/O. K. A. Gilroy

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. H. J. Bemmett.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—W/O. R. J. Clarke.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—F/O. F. H. Thompson, D.F.M.

MISSING.—F/O. G. R. Stinson.

Royal Indian Air Force

KILLED ON ACTIVE SERVICE.—F/O. S. Khan.